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Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country

Final Report – State Wise Risk Assessment, Infrastructure and Institutional Assessment of Pilot States (Delhi, Maharashtra, Rajasthan, Jammu & Kashmir, Puducherry and Andaman & Nicobar Islands)

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Submitted by

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Executive Summary

Fire Service is one of the most important emergency response services in the country, which comes under the 12th schedule of the constitution dealing with Municipal functions. At present, fire prevention and firefighting services are organized by the concerned States and Union Territories (UTs), and Urban Local Bodies (ULBs). Directorate of National Disaster Response Force and Civil Defence (NDRF&CD, Fire Cell), Ministry of Home Affairs (MHA) render technical advice to the States, UTs, and central ministries on fire protection, prevention, and legislation. Fire services in Maharashtra, Haryana, Gujarat, Chhattisgarh, Madhya Pradesh (excluding Indore), and Punjab are under the respective Municipal Corporations. In the remaining states, it is under the respective Home Department.

The growth of fire-services in the country has been on an ad-hoc basis, without much scientific analysis of existing risks in different parts of the country. Varying risk scenarios need different types of equipment. The risk varies with geographical location such as hilly-area, coastal-area, desert–area, and with residential (high-rise, medium, and low rise-buildings), industrial, commercial area or a combination of these. Moreover, lack of knowledge management for future planning and institutional capacity and funds are also seen as one of the major challenges in addressing improvements in fire and emergency services in the country. As per a recent analysis by the Standing Fire and Advisory Council (SFAC), the overall deficiency in the country in terms of number of Fire Stations is 97.54%, in terms of firefighting and rescue vehicles is 80.04% and in terms of fire personnel is 96.28%, respectively, which is quite alarming (NDMA Guideline, 2012, CR SFAC, 2011). In consideration of this and the increasing fire risks from various hazards, the Directorate of NDRF&CD, Fire Cell, MHA planned a study called "**Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country**", to identify existing gaps in terms of availability and requirement of Fire Stations, capacity-building, trained man-power and fire-fighting, rescue, and other specialized equipments.

The **broad objectives** of the study are:

- To carry out GIS thematic map based Fire Hazard and Risk analysis though overlaying hazards and quantified risk, and classify the districts as base units into appropriate risk categories such as very high, high, medium, or low.
- To prepare a detailed Investment and Financing Plan for next 10 years for up-gradation, expansion and modernization of Fire Services, based on existing situation analysis and risk based actual requirements.
- To develop an open-source GIS based software called as a Fire Decision Support System (FDSS) containing administrative boundaries, quantified risk GIS layers and with capability of estimation of financial implications for desired capacity development.
- To prepare an Institutional Assessment and Capacity Building Plan, based on field-data collection, enquiry, spatial analysis and understanding of the availability and gaps in the fire service infrastructure.

Role of Fire Services

The primary role of fire services has been to attend to fire incidents. Besides firefighting, fire department also attends to other emergencies such as building collapse, road traffic accidents, human and animal rescue etc., and other special service calls. Some fire services also attend medical emergencies for transportation of casualties through ambulances maintained by them. Similarly, some states, like Delhi, have separate flood department with

rescue boats and trained divers. The Fire Services maintain skeletal facilities to act as *'first responders'* and wait until assistance from the flood department arrives. It is therefore, considered appropriate that the specialized facilities for such jobs is maintained and operated by the concerned department.

As indicated in the National Disaster Management Authority (NDMA) guidelines, Fire Service is one of the Emergency Support Functions (ESF). Based on DM Act 2005, various states have also formulated State Disaster Management Authorities (SDMA's) and District Disaster Management Authorities (DDMA's) both of which consider Fire Service as an ESF. It is, therefore, evident that the role of Fire Services has become multi-dimensional that includes not only attending fire incident calls but also various other emergencies. Accordingly, fire services in the jurisdiction of the respective Fire Station are required to be prepared with suitable types of equipment to deal with various emergencies.

The role of fire services also includes effective fire prevention, creating awareness on fire safety, and enforcing the inbuilt fire protection arrangements for various types of occupancies in line with National Building Code (NBC) part – IV. However, majority of the States/Municipal Fire Services are unable to enforce the fire safety provisions due to a lack of appropriate directives from the authorities controlling the function of fire services. Some of the Fire Services do not adhere to NBC and have created their own fire-safety building bye-laws, e.g., Mumbai Fire Brigade. It may be noted that in-built fire safety arrangements and escape facilities are much more important than having a fire service within the premises without the above facilities. It is, therefore, necessary to enforce the fire-safety provisions through appropriate directives to all the States/UTs by the Ministry of Home Affairs (MHA) directly or through DG, NDRF & CD office.

In addition to the regular fire services, various other organizations/ industries, such as Ports, Airports, Defence, Power, Oil and Gas, Steel, Heavy Engineering, Fertilizers, Chemicals etc. have their own fire service set-ups (including their own captive resources), in order to provide fire protection to their facilities and some of them at times provide support to local fire services on request. All of them have their rules and regulations concerning fire safety. For example, Oil India Safety Directorate (OISD) norms for Oil and Gas Industries, International Civil Aviation Organization (ICAO) norms for Airports, Tariff Advisory Committee (TAC) regulations- now discontinued, for industries etc. and Electricity Rules for power sector.

Safety of highly hazardous processing and storage industries requires 100 percent round the clock built-in and functional fire protection arrangements with trained fire fighters as well as onsite and off-site disaster management plans. Fire services are not expected to create the infrastructure to independently tackle such emergencies within the industry, as it may be not be possible to do so. However, they are expected to support any on-site and off-site firefighting to protect surrounding populations and handle such incidents during transportation through the civil areas. Moreover, local fire services should have mutual-aid schemes with all the industries in their jurisdiction and must be aware of the various arrangements available with them in order to provide efficient support, in case of an emergency.

Phased Approach

In order to conduct this study for India, a vast country covering all the States and Union Territories (UTs), it was decided to conduct this study in a phased manner. In this initial phase, the pilot study comprises of 6 states and UTs (Jammu & Kashmir, Rajasthan, Maharashtra, Delhi, Andaman & Nicobar Island, and Puducherry).

Field Surveys for Fire Infrastructure Data

To collect and collate the information on Fire Infrastructure of these Pilot States/ UTs, RMSI team developed two detailed forms "Headquarter Data Collection Form" and individual "Fire Station Field-Survey Form". RMSI team field-surveyed all the Fire Stations in pilot States/UTs for collecting detailed fire Infrastructure information. The detailed information collected includes address of Fire Station, name of Fire Station in-charge, emergency contact numbers, communication between Fire Station control room, public and headquarter control room; Fire Station building including staff accommodation and barracks; firefighting vehicles and specialized equipment; fire personnel, their duty pattern and pay-scales; water availability and water sources for fire vehicles, fire-risk in the jurisdiction of Fire Station and its geographical coordinates (latitude, longitude -by using a Global Positioning System, GPS) etc. All this information for each Fire Station has been digitally converted and is available through Fire Decision Support System (FDSS), which can generate a Fire Station report at the click of a button.

GIS based Fire Hazard and Risk Analysis

In general, fire risk is defined as the combination of hazard potential, exposure, and vulnerability:

Risk = F (**H**azard potential x **E**xposure x **V**ulnerability)

The occurrence of fire incidents that constitute a threat for the population and exposed infrastructure of a certain region is associated with economic and human losses, always as a function of the exposure conditions and the vulnerability of the exposed assets in that particular region. Different natural hazards such as seismic (earthquake), climatic, and wind are considered in risk analysis. Additionally hill zone are also considered in risk analysis due to increased fire risk from wooden houses and heating provisions in cold areas.

For estimating exposure and its vulnerability, detailed urban agglomerate classification maps generated from high-resolution satellite images have been used. With the help of remote sensing techniques applied on high-resolution satellite imageries, various types of urban agglomeration areas have been demarcated. These include urban, semi-urban, building blocks, and industrial and rural villages' built-up areas of different densities (high medium, low). For exposure vulnerability, 4 different layers such as population density, residential built-up areas, high-rise building block density, and industrial areas have been developed individually at district level. For assessing fire risk, both absolute built-up areas in sq km as well as built-up areas percent (ratio of built-up areas to the total area) are considered as important parameters. It is obvious that industrial areas in districts have much lower percentages than residential built-up areas. However, presence of industrial areas in a district has a significant influence in assessing fire risk. Hence, industrial areas in absolute terms (sq km) have been considered in risk ranking.

In order to assess the impact of each exposure vulnerability type, a vulnerability score/ ranking has been assigned to each layer at their base unit. The vulnerability score represents the level of vulnerability (very high to negligible) of a specific type of exposure in response to the occurrences of small and medium fire incidents. The natural break in value distribution has been considered for defining the ranking class.

After developing ranking of individual units of hazard and exposure vulnerability, GIS layers have been overlaid on top of each other and a spatial analysis has been performed for integration in GIS environment. For combining hazard and risk, Weighted Factor Analysis (WFA) in GIS environment has been performed. Weighted ranking scores have been used in the integration analysis and quantified risk distribution for each district. Values of weighted factor depend upon the importance of a particular hazard/ vulnerability class in risk analysis.

For integration of hazards, equal weights have been assigned to wind, seismic and climatic hazards, while double weights have been given to hill zoning. This is because, in hilly terrain, wooden houses and heating provisions in buildings increase the chances of fire-incidences, and thus have been given higher weightage.

After obtaining integrated individual weighted score for hazard and exposure vulnerability, fire risk categories have been obtained in quantitative terms by further integration of hazard and exposure vulnerability. It is obvious that in the occurrence of the number of fire incidents in a given district, exposure vulnerability has more importance than the prevailing hazard. Hence, in quantified integration, double weights have been assigned to exposure vulnerability. The quantified numeric values of district risk scores are again grouped into four descriptive categories of district level risk ranking (very high, high, medium, and low).

As per project scope of work, countrywide district level fire hazard and risk analysis has been carried out. However, it is obvious that the fire risk is not uniformly distributed throughout the districts in both urban and rural areas. Considering the above fact, RMSI has performed GIS based risk analysis, based on distribution of population agglomeration by defining built-up areas into different risk categories, such as high-density urban, low-density urban, sub-urban, and village. Moreover, distinct demarcated industrial areas have also been considered in the analysis.

Review of International and National Norms

To estimate the gaps from the existing position in terms of number of Fire Stations and their appropriate location, the RMSI team followed scientific and innovative GIS based response time network analysis approach involving various norms and regulations. Various international and national norms on response time have been reviewed. Response time is defined as "*en route time (in minutes) taken by the firefighting vehicle from the Fire Station to the fire emergency scene.*" Different counties follow different norms on response time such as:

Germany: response time in urban areas varies from 8 to 15 minutes

Japan: response time varies from 5 to 10 minutes, depending upon the location of the building

USA: response time varies from (3-4) to 8 minutes

United Kingdom: response time varies from 5 to 8 minutes

India: SFAC norms recommended response time for first fire tender is 3, 5, and 7 minutes respectively depending on risk category A, B, and C in urban area and 20 minutes in rural area. The norms also defined one Fire Station in an area of 10 sq km in urban area; and 50 sq km in rural area.

To investigate the practicability of SFAC norms, RMSI team carried out a number of simulations using GIS based network analysis. With these simulations, RMSI demonstrated that two SFAC norms (response time and area-based) are not in synchronization with each other, and recommended revised response time based norms for positioning a Fire Station, as response area will vary from place to place depending upon the road network.

- ***Depending upon the risk category, the recommended response time for first fire tender is 5 to 7 minutes in urban areas and 20 minutes in rural areas***

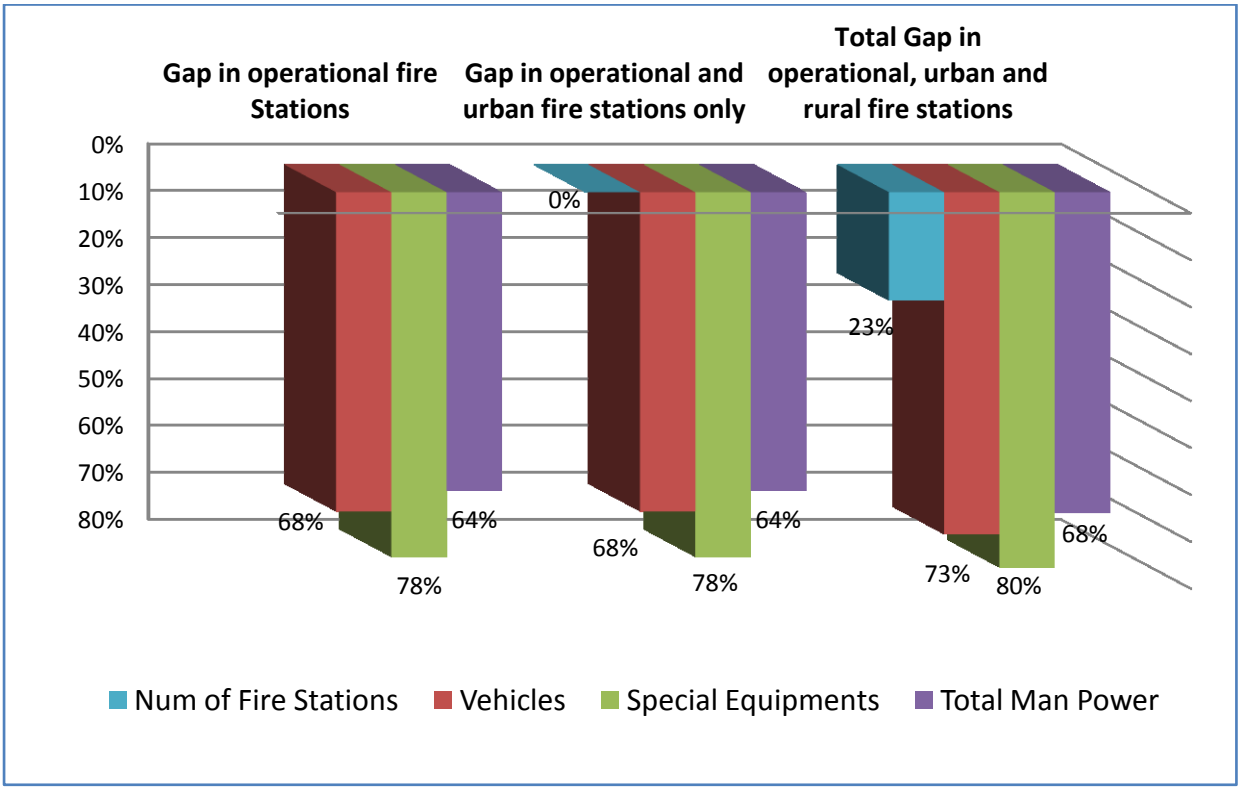
Summary of Findings for Andaman and Nicobar (A&N) Islands

Presently, A&N Fire Services has 20 operational Fire Stations and 1 Training Centre-cum-Headquarter Fire Station at Abardeen, Port-Blair.

Based on detailed demarcated built-up areas and GIS based network analysis (response time analysis), ideal jurisdiction boundaries have been demarcated for all operational Fire Stations excluding areas served by other agencies, such as ports, airports, military cantonments, thermal power plants etc. The remaining areas, not covered under ideal jurisdiction of operational Fire Stations, are also divided for ideal jurisdictions of new proposed Fire Stations. The requirements for firefighting and rescue vehicles and specialized equipments are based on ideal served population, population density, and built-up areas within ideal jurisdiction boundary.

Fire Station Gap Analysis

As per detailed GIS based analysis, the A&N Fire Services would require additional 6 Rural Fire Stations, which is an overall deficiency of 23% (for details, please refer to section 12.4.1).



Vehicles and Specialized Equipment Gap Analysis

For estimating the gap in firefighting and rescue vehicles and specialized equipment in operational as well proposed Fire Stations both in urban and rural areas, the RMSI team modified the SFAC norms with expert opinions. These modifications also helped in optimization of resources and are detailed in section 12.4.1. Thus, this study finds an overall gap of about 73% in firefighting and rescues vehicles and about 80% in specialized equipment for both operational and new Fire Stations in urban and rural areas.

Fire Personnel Gap Analysis

For estimating the gap in fire personnel in operational as well new proposed Fire Stations both in urban and rural areas, the RMSI team used Administrative Reform Department (ARD, Delhi) norms based on duty pattern (double-shift) prevalent in A&N islands as ARD has already optimized the fire manpower requirement in comparison to what has been suggested in SFAC norms. Thus, this study finds an overall gap of about 68% in fire personnel.

Fire Prevention Wing

In addition to firefighting staff, there is an urgent need for fire prevention wing for inspection, awareness generation, and training for schools, hospitals, high-rise buildings, govt. offices, public buildings etc., so that recurrence of the fire incidences similar to that at the Advance Medical Research Institute (AMRI), Kolkata, in terms of their magnitude and frequency can be reduced. Accordingly, to support Dy. Director, A&N Fire Services, additional officers at the levels of Chief Fire Officers (CFO), Dy Chief Fire Officers (Dy-CFO), Division Officers (DO), and Assistant Divisional Officer (ADO) have been recommended (for details, please refer to section 12.4.1.2).

Fire Station, District and UT Levels Report Generation

The detailed report of Operational Fire Station, district and UT levels for fire infrastructure and gap analysis is also available through Fire Decision Support System (FDSS), which can generate report for each Operational Fire Station, district, and UT level reports at the click of a button.

Roadmap for Investment and Financial plan for next 10 years

The other tasks include the development of Investment and financial plan, Institutional assessment & capacity building plan along with a Fire Decision Support System (FDSS). As detailed in section 12.5, the detailed investment and financial plan at district level includes estimation of capital cost for infrastructure cost, firefighting and rescue vehicles, and specialized fire and communication equipment. The recurring expenditure cost includes fire personnel cost depending upon pay-scales at various levels; staff uniform cost, and personal protective equipment (PPE); annual vehicle and specialized equipment maintenance cost, petrol, diesel, and lubricant (PDL); building maintenance; office and training expenses etc. The detailed roadmap and investment plan (section 12.6) for the next 10-years includes both capital and recurring expenditures. Thus, RMSI analysis estimates a total investment of about **Rs.1,072 Crores** spread over a period of 10 years for A&N Fire Services including inflationary factors and after filling the gaps for both operational and proposed urban and rural Fire Stations.

Prioritization of New Fire Stations

The prioritization of new proposed Fire Stations has been detailed in section 12.7.

Avenues for Fund Generation

Andaman and Nicobar Island Police Fire Service can generate new avenues for funds from the followings:

- Introduction of Fire Tax (1% of existing property tax)
- Introduction of Fire Cess, which can be collected for auditing and inspecting various residential, commercial, and industrial occupancies for adoption of Fire Safety Measures besides training public manpower for use of first aid firefighting equipment

- Training programs at different levels and duration to private sector employee on chargeable basis
- Sale of condemned fire appliances, equipments, uniform articles and general store items
- Clearance of building plans from fire safety point of view

Capacity Building and Training Facilities

The Capacity Building and Training facilities and training need assessment for various levels have been given in section 12.9.

Limitations of study

Limitations of study have been given in section 12.10.

Recommendations

The report concludes with the recommendations for the A&N Fire Services and is detailed in section 12.11. In short, A&N Fire Services can be revamped in the next 10 years to desired level, if sufficient funds and trained resources are made available.

Report Structure

This report for pilot States/UTs is divided in two parts:

Part A: This part comprises of chapters 1-6, which are common for all the pilot states/UTs- Delhi, Jammu & Kashmir, Rajasthan, Puducherry, Maharashtra, and Andaman & Nicobar Islands.

- Chapter 1 provides brief details of project background, role of fire services, objective and scope of study
- Chapter 2 outlines the methodology adopted and data development
- Chapter 3 provides details on GIS based fire hazard and risk analysis
- Chapter 4 provides a brief overview of field-survey of individual Fire Station and headquarter data collection and approach for stakeholder analysis
- Chapter 5 briefly explains the Development of Fire Decision Support System (FDSS)
- Chapter 6 examines international and national norms

Part B: This part comprises of Chapters 7-12, which are prepared for pilot state/UT specific.

- Chapter 7 provides detailed analysis for the Delhi State
- Chapter 8 provides detailed analysis for the Rajasthan State
- Chapter 9 provides detailed analysis for the Maharashtra State
- Chapter 10 provides detailed analysis for the Jammu & Kashmir State
- Chapter 11 provides detailed analysis for the Puducherry UT
- Chapter 12 provides detailed analysis for the A&N Islands UT

For Part-B, this report consists of Chapter 12, which is for the A&N Islands UT.

PART -A

1 Introduction

1.1 Background

Fire service is one of the most important emergency response services. In India, Fire services come under the 12th Schedule of the constitution dealing with Municipal functions. At present, fire prevention and firefighting services are organized by the concerned States and Union Territories (UTs), and Urban Local Bodies (ULBs). Ministry of Home Affairs (MHA) renders technical advice to the States, UTs, and central ministries on fire protection, prevention, and legislation. Fire services in Maharashtra, Haryana, Gujarat, Chhattisgarh, Madhya Pradesh excluding Indore, and Punjab are under the respective Municipal Corporations. In remaining States, it is under the Home Department (Figure 1-1).

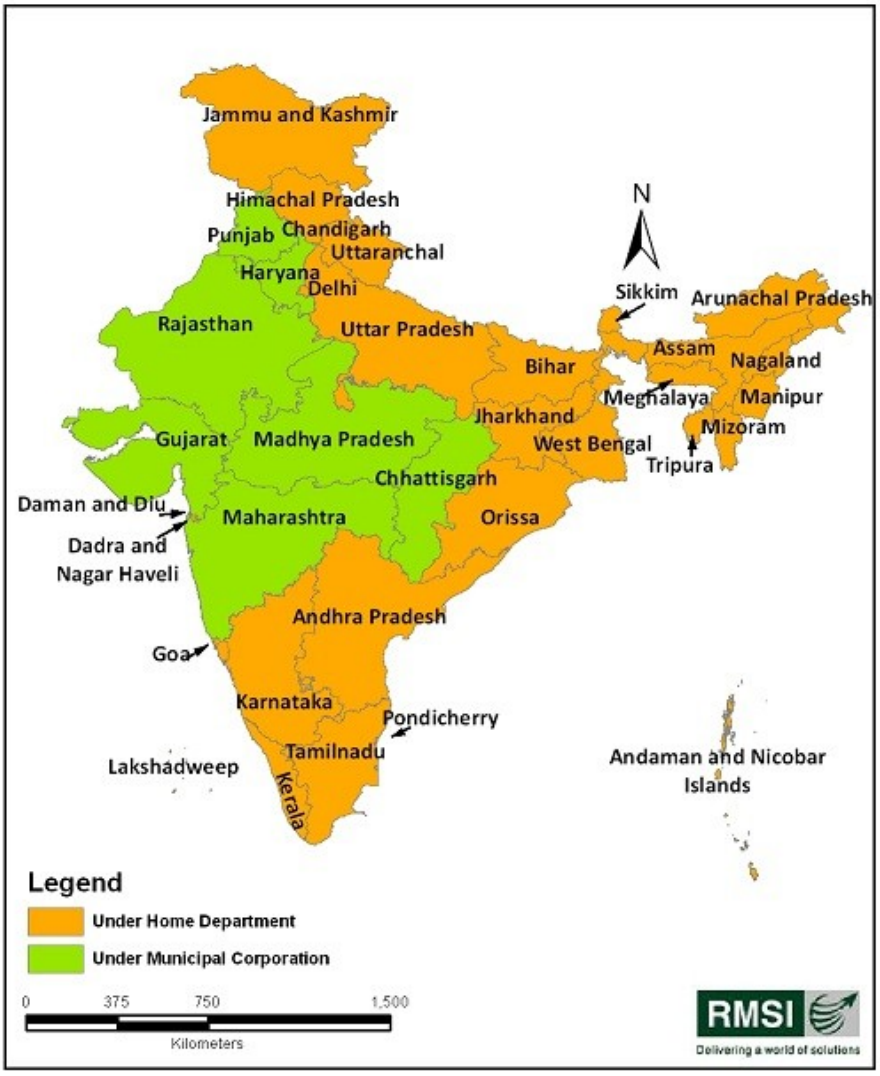


Figure 1-1: Distribution of fire services by various States/UTs by administrative organization

1.2 Role of Fire Services

As far as the role of fire services is concerned, the primary job of fire services has been to attend to fire incidents. However, they also attend to other emergencies like rescue from building collapse, road traffic accidents, human and animal rescue etc., and other special

service calls. Some fire services also attend medical emergencies for transportation of casualties through ambulances maintained by them. Similarly, some States have separate flood department with rescue boats and trained divers, like Delhi. The Fire Services maintain skeleton facility to act as 'first responder' and wait until assistance from flood department is reached. It is therefore, considered appropriate that the specialized facilities for such job is maintained and operated by the concerned department.

As indicated in the National Disaster Management Authority (NDMA) guidelines, Fire Services is one of the Emergency Support Functions (ESF). Based on DM Act 2005, various States have also formulated State Disaster Management Authorities (SDMA's) and District Disaster Management Authorities (DDMA's) both of which consider Fire Service as an ESF. It is therefore evident that the role of Fire Service is multi-dimensional that includes attending various emergencies. Accordingly, fire services are required to be prepared with suitable types of equipment to deal with various emergencies arising in the jurisdiction of the respective Fire Station.

The role of fire services also includes effective fire prevention, creating awareness on fire safety, and enforcing the inbuilt fire protection arrangements for various types of occupancies in line with National Building Code (NBC) part – IV. However, some of the States/Municipal Fire Services are unable to enforce the fire safety provisions due to a lack of appropriate directives from the authorities controlling the function of fire services. Some of the Fire Services do not adhere to NBC and have created their own fire-safety building bye-laws, e.g., Mumbai Fire Brigade. It may be noted that in-built fire safety arrangements and escape facilities are much more important than having a fire service within the premises without the above facilities. It is, therefore, necessary to enforce the fire-safety provisions through appropriate directives to all the States/UTs by the Ministry of Home Affairs (MHA) directly or through DG, NDRF & CD office.

In addition to the regular fire services, various other organizations/ industries, such as Ports, Airports, Defence, Power, Oil and Gas, Steel, Heavy Engineering, Fertilizers, Chemicals etc. have their own fire service set-ups (including their own captive resources), in order to provide fire protection to their facilities and some of them at times provide support to local fire services on request. All of them have their rules and regulations concerning fire safety. For example, Oil India Safety Directorate (OISD) norms for Oil and Gas Industries, International Civil Aviation Organization (ICAO) norms for Airports, Tariff Advisory Committee (TAC) regulations- now discontinued, for industries etc. and Electricity Rules for power sector.

Safety of highly hazardous processing and storage industries requires 100 percent round the clock built-in and functional fire protection arrangements with trained fire fighter as well as onsite and off-site disaster management plans. Fire services are not expected to create the infrastructure to independently tackle such emergencies within the industry, as it may be not be possible to do so. However, they are expected to support any on-site and off-site firefighting to protect surrounding populations and handle such incidents during transportation through the civil areas. Moreover, local fire services should have mutual-aid schemes with all the industries in their jurisdiction and must be aware of the various arrangements available with them in order to provide efficient support, in case of an emergency.

The growth of fire-services in the country has been on an ad-hoc basis, without much scientific analysis of existing risks in different parts of the country. Varying risk scenarios need different types of equipments depending upon the risk and geographical location such as hilly-area, coastal-area, desert–area, and residential (high-rise, medium, and low rise-buildings), industrial, commercial area or a combination of these. Moreover, lack of knowledge management for future planning and institutional capacity and funds are also seen as major challenges in addressing improvements in fire and emergency services in the

country. As per a recent analysis by the Standing Fire and Advisory Council (SFAC), the overall deficiency in the country in number of Fire Stations is 97.54%, in firefighting & rescue vehicles 80.04% and in fire personnel is 96.28%, respectively, which is quite alarming (NDMA Guideline, 2012, CR SFAC, 2011).

In consideration of this and the increasing risks from various hazards, such as Fire Following an Earthquake (FFEQ), and the rapid pace of urbanization and industrialization in the country, the Directorate of National Disaster Response Force and Civil Defence (NDRF&CD, Fire Cell), MHA felt the need for a comprehensive study to identify existing gaps in terms of availability and requirement of Fire Stations, capacity-building, in terms of trained man-power and fire-fighting, rescue, and other specialized equipments. This comprehensive study **aims at preparing a perspective plan for the next 10 years for revamping the fire services in the country**.

1.3 Objective of the Study

The broader objective of this study is to prepare a Capital Investment and Institutional Strengthening plan for accelerated development of fire services in the country.

1.4 Scope of the Study

The study area for this assignment is the entire country under the Directorate of NDRF & Civil Defence (Fire). The scope of the assignment will include, inter alia, the following activities:

1. **Fire Hazard & Risk Analysis:** Carry out a GIS (Open Source) based fire hazard and risk analysis and identify the gaps in fire services in terms of firefighting vehicles, specialized equipment, and trained fire personnel.
2. **Investment and Financing Plan:** Assess the status, availability and distribution of the fire service infrastructure under the Directorate of NDRF & Civil Defence (Fire Cell) by conducting field investigations and interviews. It is expected to conduct an investigation to assess the gaps and needs for future planning and up-gradation/ modernization of the fire service infrastructure in the country in a quantified approach. As part of the Investment and Financing Plan, it is also expected to estimate the Capital and O&M Investment plan for the next 10 years and the investment priorities.
3. **Institutional assessment and capacity building plan:** Based on field-data collection, enquiry, spatial analysis and understanding on the availability and gaps in the fire service infrastructure, and prepare an institutional assessment and capacity-building plan for the department. Institutional Assessment and Capacity Building Plan will include but will not be limited to understanding the policies, regulations, strategies and programs of the department; existing legal and institutional mechanisms, issues and constraints of effective management; and training needs and capacity of the department's resources. Based on a comprehensive understanding of the mentioned variables, it is expected to prepare a consolidated national report and key recommendations for the Directorate of NDRF & CD (Fire Cell). It is also expected to explore the possibility of funding sources and provide recommendations for improvements to ensure appropriate financing mechanisms for capital expenditure, and for operation and maintenance.

2 Technical Details on Methodology and Data Development

2.1 Understanding of the Scope of Work

The primary objective of this comprehensive study on "Fire Hazard and Risk Analysis in the Country" is to prepare a capital investment and institutional strengthening plan for accelerated Development of Fire Services in the country. To achieve this objective of the study, the Directorate of NDRF & CD has defined the broad scope of the work as:

1. Risk and Hazard Analysis
    - Identifications of gaps in the existing fire services
2. Investment and Financial Plan
3. Institutional Assessment and Capacity Building Plan
    - Including survey of NFSC Nagpur and regional fire training Centers

As part of the Risk and Hazard Analysis, it is expected to carry out a GIS based hazard, risk analysis at base unit (district) level, and identify the gaps in the existing fire services. Risk assessment of forest fire is not included under the present scope of work. The infrastructures of forest department, privately owned fire safety infrastructure, infrastructures in restricted areas like military cantonments and airbases, and ammunition depots; nuclear facilities such as nuclear power plants, nuclear research reactors, heavy water plants; and mines, ports, airports, and oil exploration and oil refineries are excluded from the study. While assessing the infrastructure for the Investment and Financing Plan, RMSI has focused specifically on the State/ UT Fire Services. ***However, it may please be noted that RMSI team is also making efforts to get details of areas served by other agencies as well, so that requirement of establishing Fire Stations in these areas does not become part of the Gap analyses.***

As part of the 'Investment and Financing Plan', it is expected to assess the status, availability and distribution of the fire service infrastructure under the jurisdiction of Director General (NDRF & Civil Defence) through conducting field investigations and interviews. It is also expected to conduct an investigation to assess the gaps and needs for future planning, up gradation/ modernization of the fire service infrastructure in the country through a quantified approach. As part of the Investment and Financing Plan, it is also expected to estimate the Capital and O&M Investment plan for the next 10 years and the investment priorities. Based on the field data collection, enquiry, spatial analysis and understanding on the availability and gaps in the fire service infrastructure, it is expected to prepare an institutional assessment and capacity-building plan for the department. Institutional Assessment and Capacity Building Plan will include but not limited be to understanding the polices, regulations, strategies and programs of the department; existing legal and institutional mechanisms, issues and constrains of effective management; training needs and capacity of the department's resources. Based on a comprehensive understanding of the mentioned variables, it is expected to prepare a consolidated National Report and key recommendations for the Director General (NDRF & Civil Defence) for all the Fire Stations under jurisdiction of the Directorate of NDRF & CD. Moreover, the possibility of funding sources will also be explored, and recommendations will be made for improvements to ensure good financing mechanisms for capital expenditure and operation and maintenance.

2.2 Study Area

The study area for this assignment is the entire fire service area of the country under the Directorate of NDRF & Civil Defence (Fire Cell). RMSI has carried out physical survey of all the Fire Stations under the Directorate of NDRF & CD (Fire Cell) (Figure 2-1) across the country.

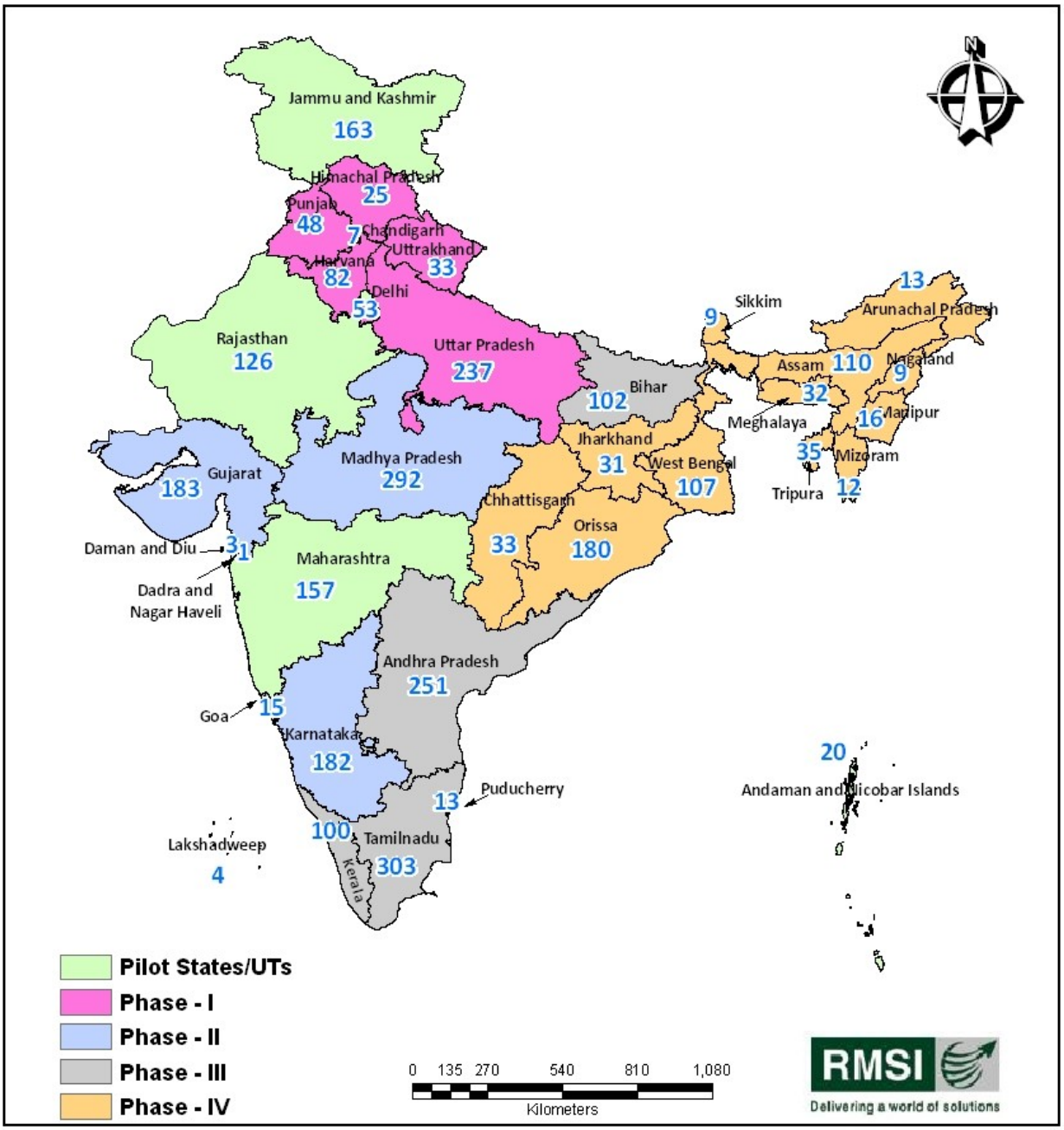


Figure 2-1 : State/UT wise distribution of Fire Stations in India

2.3 Phased Approach

As India is a vast country and in order to conduct this study for all the States and Union Territories (UTs), it was decided to conduct this study in a phased manner (Table 2-1). The initial phase pilot study comprises of six States and UTs - **Jammu & Kashmir, Rajasthan, Puducherry, Maharashtra, Andaman & Nicobar Island**, and **Delhi**, and other States/UTs have been taken up in subsequent Phases (Phase I to Phase IV), detailed in section 2.2. The Fire- Infrastructure of all States/ UTs have been Field–Surveyed by RMSI team and fire hazard and risk analyses have been carried out. The other tasks include development of Investment and Financing Plan, Institutional Assessment & Capacity Building Plan along with a prototype Fire Decision Support System (FDSS). The outcomes of pilot study were submitted to the Expert Group of the project for their review and approval and detailed discussions were held with senior Fire Officials, MHA and respective State/UT representatives. The approved report have been used as a template for conducting the study for the remaining States/ UTs in the phased manner indicated in Table 2-1.

It may be noted that there could be region specific modifications and variations in the requirements of different kinds and types of firefighting equipments depending upon the risk category of the district (base unit) of Fire Station, its geographical location such as coastal-area, hilly-area and desert–area. Phase wise list of States/UTs also includes corresponding number of districts (Census, 2011), number of Talukas/ Mandals/ Tehsils (Census, 2001), and number of Fire Stations (Table 2-1).

Table 2-1: Phase wise distribution of various States/UTs in the Country

States	No of Districts (Census 2011)	No of Talukas/ Tehsils/ Mandals (Census 2001)	No of Fire Stations
Pilot Phase			
NCT of Delhi	9	27	53
Maharashtra	35	355	157
Puducherry	4	15	13
Andaman & Nicobar Islands	3	7	20
Rajasthan	33	241	126
Jammu & Kashmir	22	59	163
Phase I			
Chandigarh	1	1	7
Haryana	21	67	82
Punjab	20	72	48
Himachal Pradesh	12	109	25
Uttarakhand	13	49	33
Uttar Pradesh	71	300	237
Phase II			
Madhya Pradesh	50	259	292
Gujarat	26	227	183
Daman & Diu	2	2	3
Dadra & Nagar Haveli	1	1	1
Karnataka	30	175	182
Goa	2	11	15
Phase III			
Kerala	14	63	100
Lakshadweep	1	4	4
Tamil Nadu	32	202	303
Andhra Pradesh	23	1110	251
Bihar	38	533	102
Phase IV			
West Bengal	19	343	107
Assam	27	145	110
Manipur	9	38	16
Meghalaya	7	32	32
Mizoram	8	25	12
Sikkim	4	9	9
Tripura	4	38	35
Nagaland	11	93	9
Arunachal Pradesh	16	149	13

States	No of Districts (Census 2011)	No of Talukas/ Tehsils/ Mandals (Census 2001)	No of Fire Stations
Orissa	30	398	180
Chhattisgarh	18	97	33
Jharkhand	24	210	31
Total	**640**	**5,466**	**2,987**

3 GIS based Fire Hazard and Risk Analysis

Based on RMSI's vast experience of executing large projects at state and country levels, RMSI team has adopted the following approach (detailed below) to carry out this assignment. This approach has also been presented and discussed in a series of meetings with the officials of the Directorate of NDRF & CD, MHA, Government of India.

The risk of fire in urban areas has increased over the years and the rising cost of fire losses would seem to indicate that they are increasing at a greater rate than the measures devised to control them. Cities are growing in size and complexity day by day; therefore, they need to be managed more efficiently.

Geographic Information System (GIS) is an important and efficient tool that can be used by local administrations to minimize natural disasters (Recep Nisanci, 2010). Although there are many formal definitions of GIS, for practical purposes GIS can be defined as a computer-based system to aid in the collection, maintenance, storage, analysis, output and distribution of spatial data information (Bolstad, 2005). Thus, GIS technologies have been used in fire analysis related to the optimum location of Fire Stations. For example, Habibi et al. (2008), has made spatial analysis of urban Fire Stations in Tehran, using an analytical hierarchy process and GIS. Yang et al. (2004) also carried out studies concerning the selection of Fire Station locations using GIS.

Unlike a flat paper map, a GIS-generated map can represent many layers of different information. This representation provides a unique way of thinking about geographic space. By linking map databases, GIS enables users to visualize, manipulate, analyze and display spatial data. GIS technology based approach is cost-effective and provides accurate solutions in an expanding range of applications. RMSI team is adopting following approach for fire risk analysis of Indian states.

3.1 GIS Data Compilations

GIS Map based fire hazard and risk analysis is one of the main tasks of this assignment. In order to undertake hazard and risk analysis, various GIS layers and other associated thematic maps have been created for each of the Pilot States/UTs that form the basis for risk ranking of base units (districts). The following is a list of selected GIS layers as base administrative layers and other dependant layers that have been used in GIS based fire risk analyses.

1. State administrative boundary layers
2. District administrative boundary layers
3. Rail network
4. Major (highways) and main road networks
5. Minor roads/ street road networks
6. Locations of cities, and major towns with their names
7. State level Land use land cover maps
8. Demarcation of residential, commercial and industrial built-up areas
9. Census population data (2011)
10. Geographical locations (latitude, longitude) of operational Fire Stations
11. Other collateral data such as information from city development plans (if available), and demarcation of fire-station jurisdictional areas.

These data layers and their attribute data have been expanded according to needs analyses. The needs analyses include query information for the data needed for generating risk maps and effective firefighting planning.

After taking into account all requirements and data types, RMSI team has generated various GIS data layers for further GIS spatial analyses. District boundaries were considered as the base unit for analysis in assessing fire services infrastructure gaps, risk quantifications, and risk classifications.

GIS maps for administrative boundary layers such as state, and district are based on published Census 2011 data. **Currently, Census 2011 has published only district level demographic data.** In comparison to previous census (Census 2001), several new districts have been created. These new districts have been considered in the analysis.

Classified land use and land cover data is the backbone in fire hazard and risk analysis. Latest vintage satellite images have been used to capture the various features such as road networks, forest areas and habitat/settlement areas (Figure 3-1). The various land use land cover classes were extracted from latest vintage satellite images at 25m resolution for the selected states and UTs, and at higher resolution for major cities. The extraction is based on a semi-automated classification approach to distinguish the classes based on their reflectance values in the source satellite imagery. Data quality and data validation checks have been carried out for each stage of data generation.

For LULC classification, remote sensing satellite images were geo-referenced and classified to generate different LULC layers such as vegetation, built-up area, water bodies, and streets, based on their spectral reflectance i.e. DN (Digital Number) values. In this process, through a semi-automated process, these DN values of satellite images are classified into respective LULC classes to generate the clutter data. These clutter data layers are further subdivided into their respective sub-classes and merged together to give preliminary clutter data. The output clutter goes through standard validation processes and quality checks to produce high quality final clutters. Table 3-1 shows a list of classified LULC data at 25-meter resolution. Figure 3-1 displays delineated LULC classes for different parts of western Maharashtra (districts– Mumbai, Mumbai sub-urban, Thane, Pune and Raigarh). Figure 3-2 shows an enlarged view of classified urban agglomerate of Pune city areas.

Table 3-1: Cluster class morphology in land use maps

ID	Class Name	Description
0	**Unclassified**	Edge of the database
1	**Urban High Density**	Areas within urban perimeters, Inner city, very little/negligible vegetation. Closely packed buildings indicative of high density with only major streets and roads being visible. Absence of large open spaces.
2	**Urban Medium Density**	Medium density of buildings, vegetations are less but higher than the dense urban, major pedestrian zones being partially visible and streets and roads visible. Comparatively more open spaces exist within this region
3	**Urban Low Density**	Low density of buildings, vegetations / open area are higher than the medium urban, major pedestrian zones being partially visible and streets and roads visible. Comparatively more open spaces than medium density exist within this region
4	**Suburban High Density**	Suburban areas surrounding big cities (Outer parts of the city) with loosely packed built up and little vegetation.
5	**Suburban Low Density**	Sparse Suburban areas in outskirt of big cities (Outer parts of the city) with loosely packed built up and little vegetation.
6	**Building Blocks**	Systematic groups of buildings, parallel or not, that may be separated by large open spaces.
7	**Villages**	Unsystematic small pockets /clusters of buildings, within large agriculture / open spaces
8	**Industrial**	**Industrial:** Factories, Warehouse, Garages, Shipyards, Mostly situated outside the main cities.
9	**Commercial Areas**	**Commercial:** Central Mall, Office Complexes with large building footprints, Central Business districts, Commercial buildings within the city (like petrol pumps, gas filling stations etc.) etc. will be classified as commercial areas
10	**Forest**	All kinds of dense forest in rural areas, over hills/ mountains, Natural Parks with high tree density.
11	**Low Dense Vegetation**	Low density of trees, low vegetation, bushes, scrubs with low tree density.
12	**Agriculture/Fellow**	All kinds of agriculture/fellow cultivated areas, croplands, farmlands etc.
13	**Water**	Inland permanent water bodies. This class will consist of lakes & dams.
14	**Open**	No buildings, no vegetation e.g. desert, beach, and open lands mostly barren.
15	**Quasi Open**	Areas with some obstruction like scattered trees or bushes with some mixed built-up, open, agricultural fallow lands etc
16	**Airport**	Airstrip and terminal buildings
17	**River/Canal**	Linear water features like streams and rivers.
18	**Seasonal Water Body**	Seasonal water body
19	**Sea**	Sea

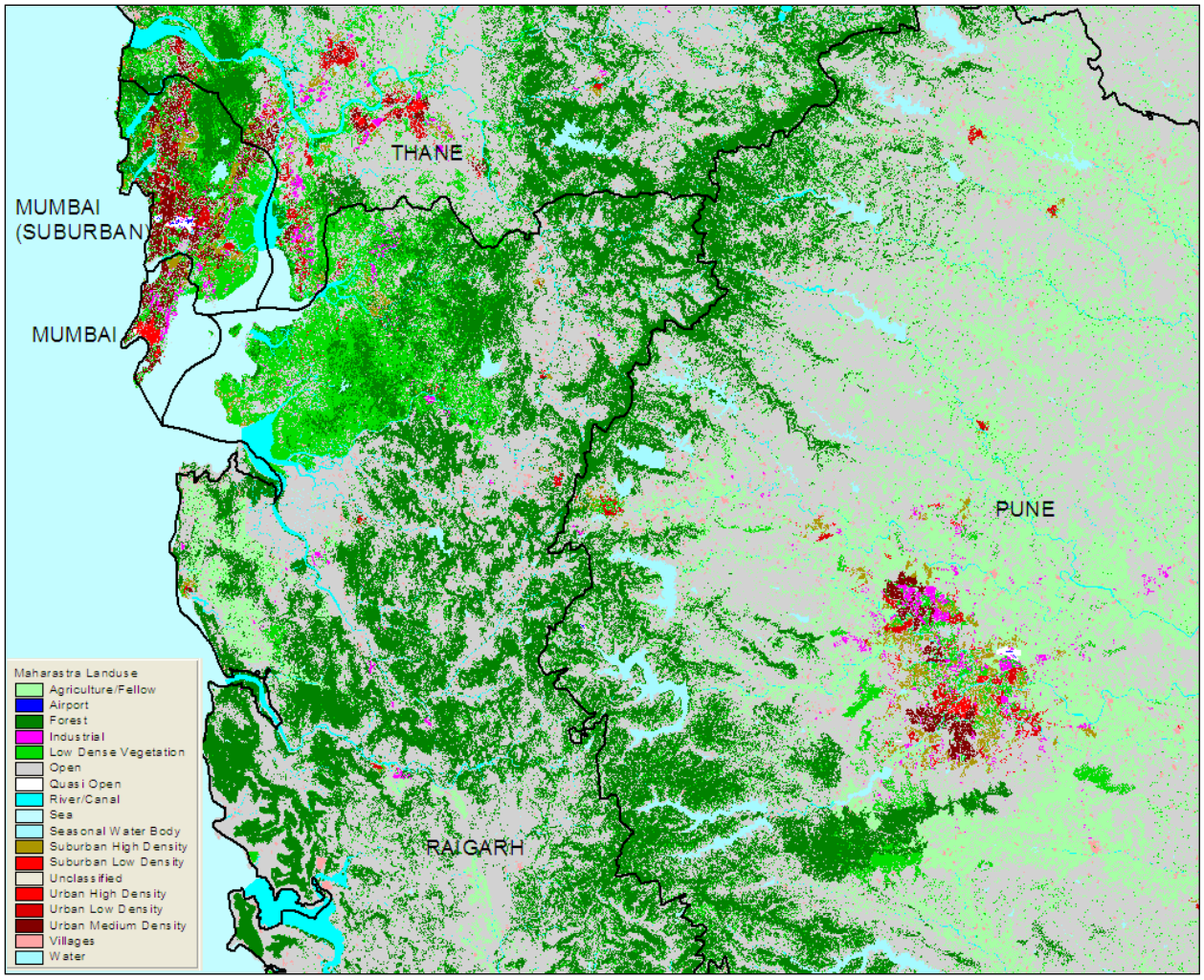


Figure 3-1 : Land use classification at 25m pixel for parts of Western Maharashtra (districts – Mumbai, Mumbai sub-urban, Thane, Pune and Raigarh)

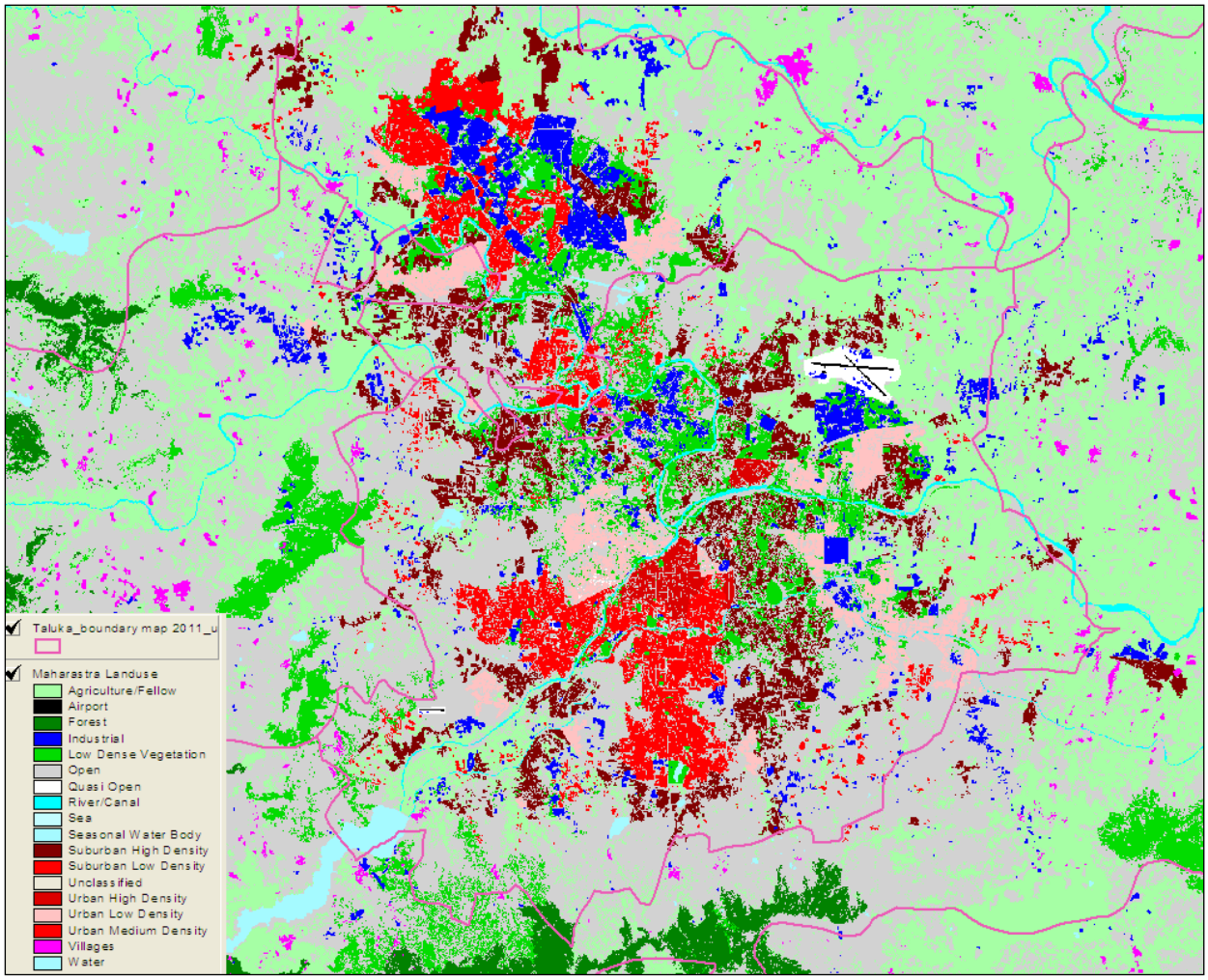


Figure 3-2 : An enlarged view of classified urban agglomeration in Pune city areas

For major city areas, classifications that are even more detailed have been created with a high-resolution data layer as shown in Figure 3-3. For major cities / towns, besides the other classified units, such as highways and main roads, minor roads/streets and localities, have been captured. After the field survey of individual Fire Stations, GPS locations of all Fire Stations have been displayed for gap analysis.

3.2 GIS - Overlay Analysis

The basic way to create or identify spatial relationships among various GIS layers is through the process of spatial overlay. Overlay is a GIS operation in which layers with a common, registered map base are joined on the basis of their occupation of space. (Keith C. Clarke, 1997). Spatial overlay is accomplished by joining and viewing together separate data sets that share all or part of the same area. The result of this combination is a new data set that identifies the spatial relationships.

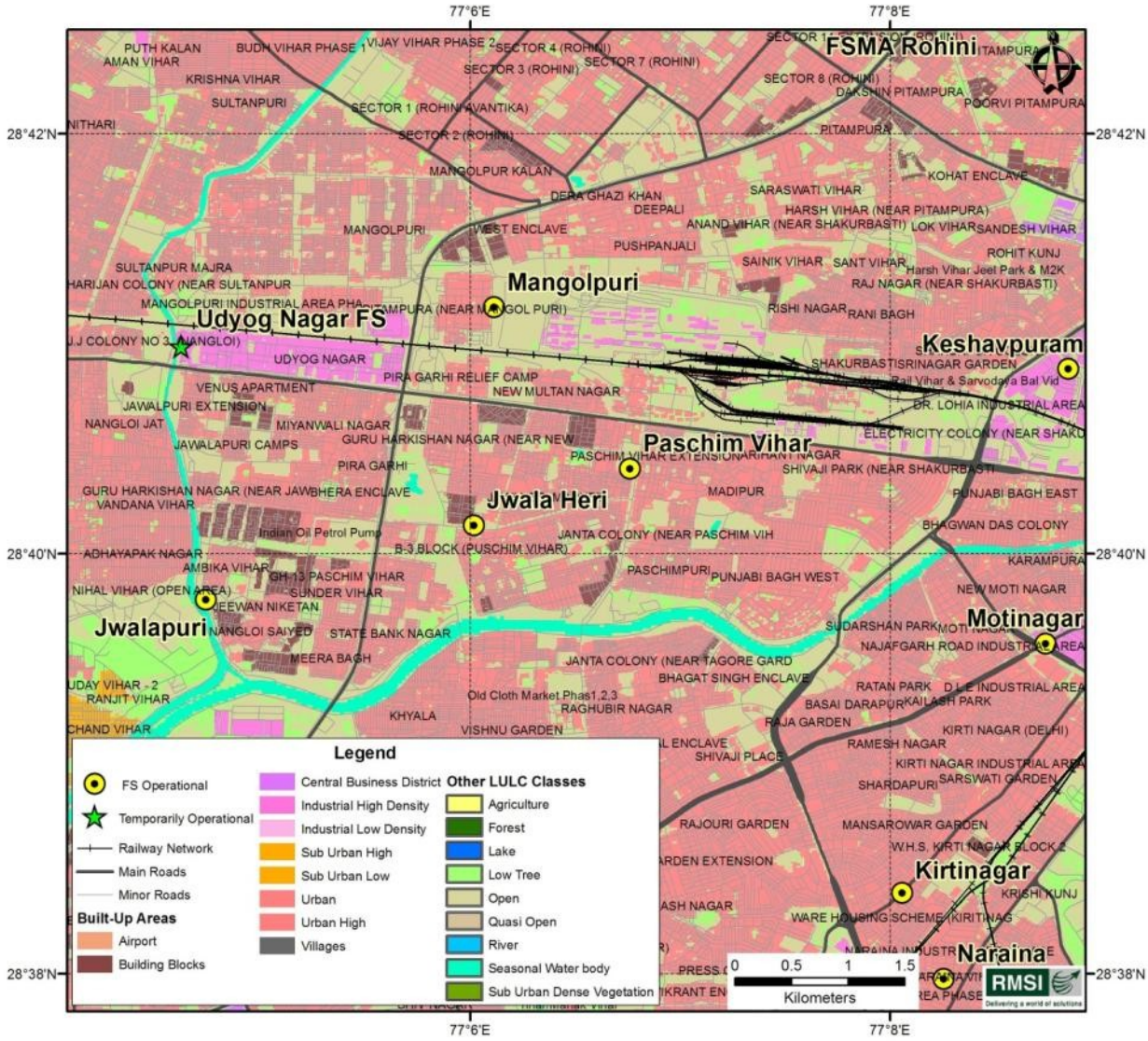


Figure 3-3 : Detailed classified urban agglomerate areas in parts of Delhi with overlay of GPS location of Fire Stations

Overlay analysis is a common, widely used method of analyzing and evaluating geospatial data. Overlay analysis utilizes map layers in GIS to discover relationships across the layers. Overlay analysis is used to investigate geographic patterns and to determine locations that meet specific criteria. Spatial overlay is illustrated and highlighted in Figure 3-4. Various data layers, such as Land Use Land Cover (LULC), composite hazard, demographic exposure, road network, administrative boundary and Fire Station locations have been used through overlay analysis by combining diverse data sets for hazard analysis and Fire Station gap analysis.

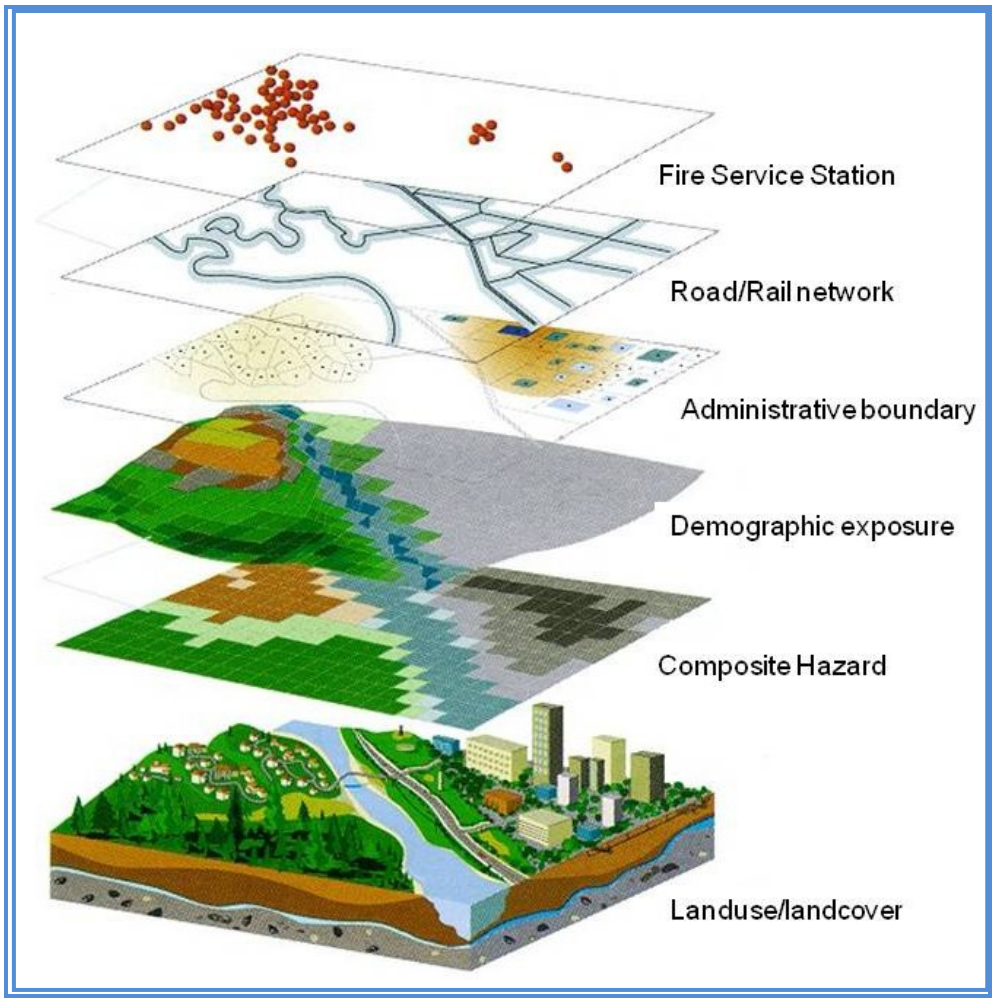


Figure 3-4 : Overlay analysis for Fire Risk Assessment

3.3 Fire Hazard and Risk Analysis

The first-turnout of fire vehicles normally originates from the Fire Station under whose jurisdiction the fire-call has been received. Sometimes, calls go to a centralized control room, from where they are directed to the concerned Fire Station. To provide an effective response, Fire Station infrastructure in the form of firefighting and rescue vehicles, specialized equipment and manpower should also take into consideration of fire risks in addition to road conditions and population distribution. Thus, hazard and risk analysis of the base unit (district) should be on a scientific basis.

In general, fire risk is defined as the combination of hazard potential, exposure, and vulnerability:

Risk = F (**H**azard potential x **E**xposure, **V**ulnerability)

The occurrence of fire incidents that constitute a threat for the population and the exposed infrastructure of a certain region is associated with economic and human losses, always as a function of the exposure conditions and the vulnerability of the exposed assets in that particular region. In the present scope, fire risk can be defined as associated with the number of small and medium fire incidents and their locations.

3.4 Hazard Ranking

Earthquake (Seismic zones)

Besides loss of life, property damage, building collapses, and loss of basic amenities such as bridge and road damage, earthquakes can also induce small to large fires. Hence, earthquake zoning is an important parameter for fire risk analysis.

Based on occurrence of earthquakes of different intensities, the Seismic Zoning Map of India (IS 1893, 2001; BMTPC, 2006; NBC 2005) divides the country into 4 seismic zones as shown in Figure 3-5. Seismic Zone V is the highest risk zone where earthquakes having intensity of IX+ on Modified Mercalli Intensity (MMI) scale can take place. Earthquakes of intensities between VIII to IX can be experienced in seismic Zone IV, whereas earthquakes can occur between VI and VIII intensity in seismic Zone III.

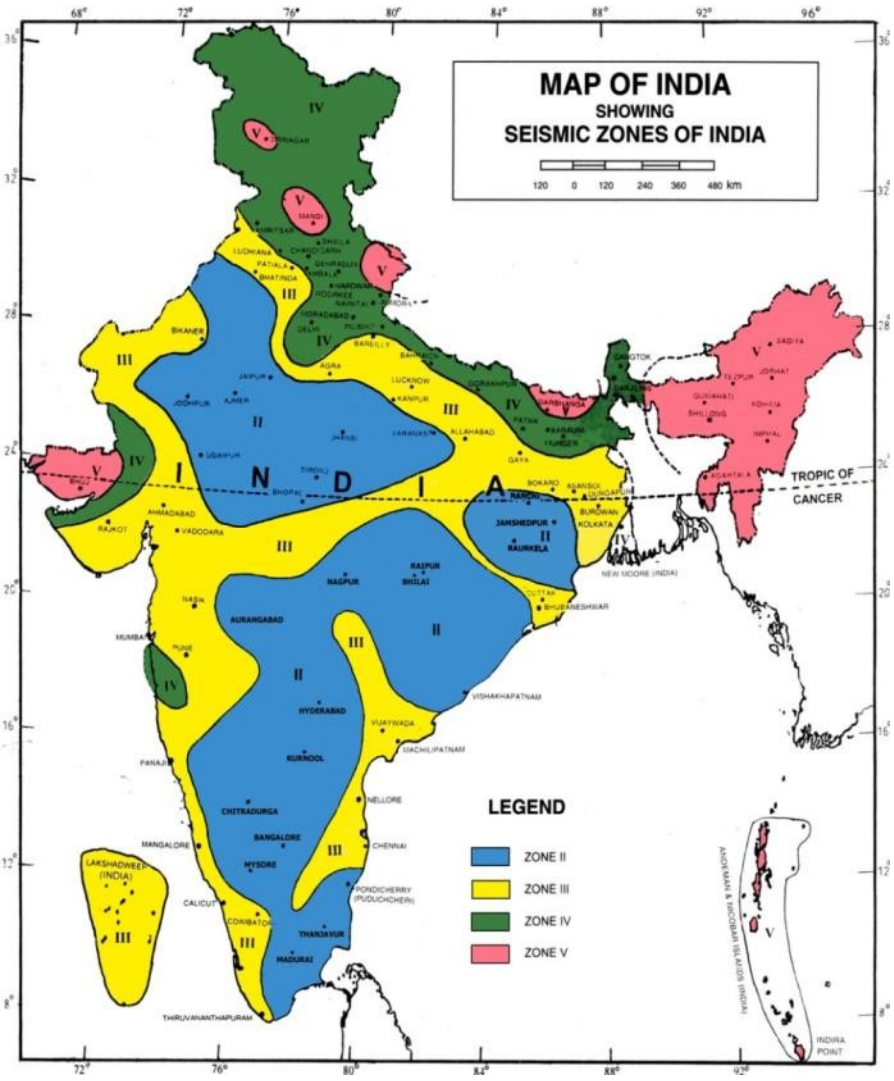


Figure 3-5 : Seismic zones of India

With GIS overlay analysis, district areas falling within each seismic zone have been computed. In order to compare seismic risk among various districts, district level ranking of seismic zones has been assigned, based on the scheme shown in Table 3-2. District level seismic ranking for pilot States/UTs is shown in Table 3-3.

Wind Zones

Prevailing wind speed is one of the important parameters in assessing fire risk in the area. Wind speed has a noticeable influence on fire spread. The wind zone map illustrates the areas vulnerable to high wind speeds (Figure 3-6). There are six basic wind speeds considered for zoning, namely:

- 55m/s (198 km/hr) Very High Damage Risk Zone-A
- 50m/s (180 km/hr) Very High Damage Risk Zone-B
- 47m/s (169.2 km/hr) High Damage Risk Zone
- 44m/s (158.4 km/hr) Moderate Damage Risk Zone-A
- 39m/s (140.4 km/hr) Moderate Damage Risk Zone-B
- 33m/s (118.8 km/hr) Low Damage Risk Zone

The coastal areas are subjected to severe windstorms and cyclonic storms. A full-grown cyclone is 150 to 1,000 km across and 10 to 15 km high. Macro-level wind speed zones of India have been formulated and published in IS 875 (Part-3) – 1987. It is known that in certain events, the wind gusts could appreciably exceed the given basic wind speeds. For assessing vulnerability and fire risk to buildings, above macro-level zonings have been considered. Based on wind speed, risk ranking has been assigned to each wind zone following the schema described in Table 3-2. District wise estimated wind risk from GIS overlay analysis is shown in Table 3-3.

Table 3-2: Risk ranking schema for earthquake, wind and climatic zones

Wind Zone	Ranking
Very High Damage Risk Zone - A (Vb=55m/s)	4
Very High Damage Risk Zone - B (Vb=50m/s)	3.5
High Damage Risk Zone (Vb=47m/s)	3
Moderate damage Risk Zone - A (Vb=44m/s)	2
Moderate damage Risk Zone - B (Vb=39m/s)	1.5
Low Damage Risk Zone (Vb=33m/s)	1
Importance Factors/ Weightage	**20%**

Seismic Zone	Ranking
ZONE V	4
ZONE IV	3
ZONE III	2
ZONE II	1
20%	

Climatic Zones	Ranking
Hot and Dry	3
Composite, Temperate	2
Warm and Humid	1
Cold Climate	1
20%	

Hill Zoning	Ranking
Cold climate	5
Other climates	1
Importance Factors/ Weightage	**40%**

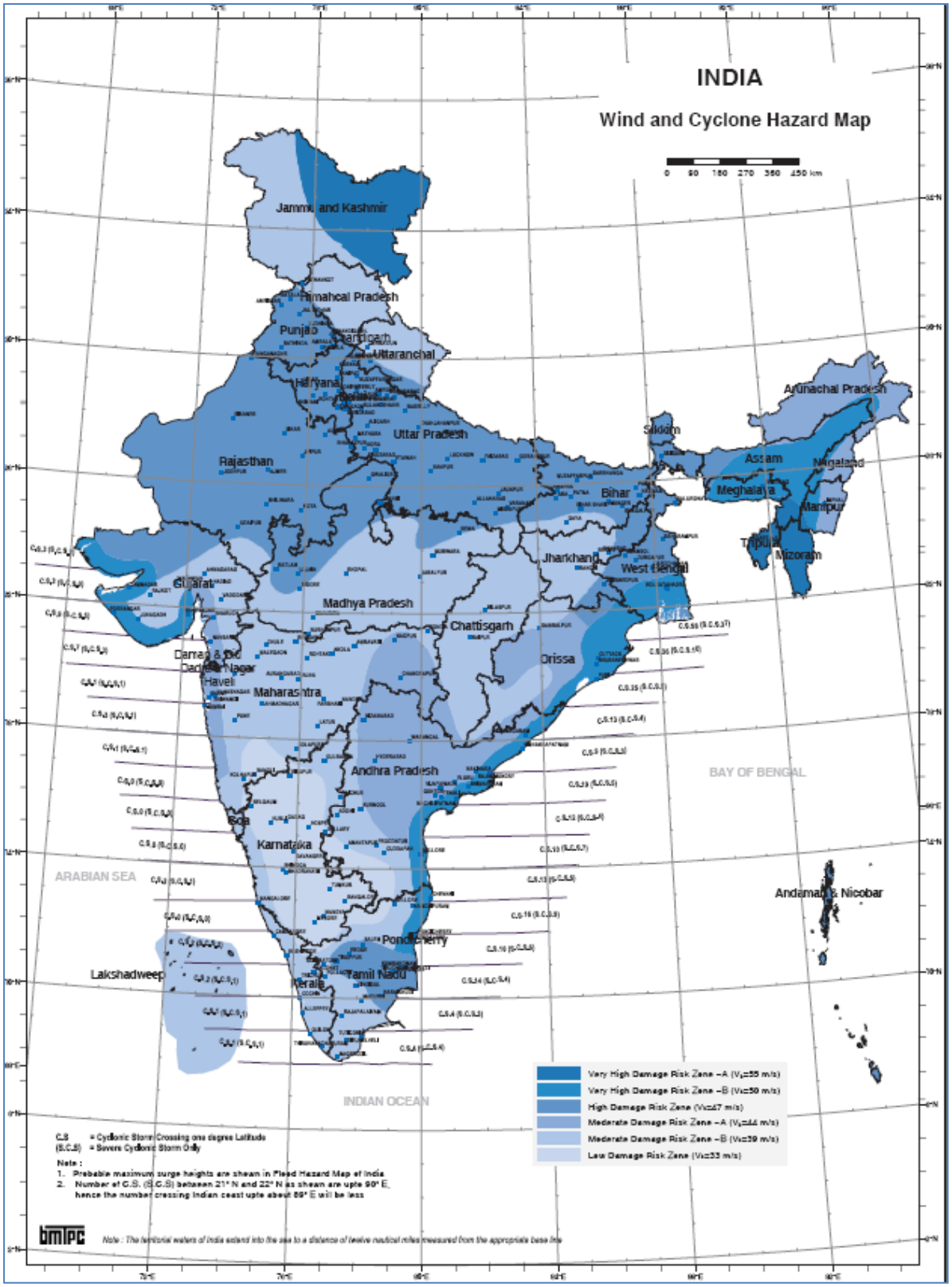


Figure 3-6 : Wind zone map of India (BMTPC, 2006)

Climatic Zones

Regions having similar characteristic features of climate are grouped under one climatic zone. According to a recent code of the Bureau of Indian Standards, the country has been divided into the following five major climatic zones:

- Hot & Dry (mean monthly temperature >30 and relative humidity <55%);
- Warm & Humid (mean monthly temperature >25-30 and relative humidity >55-75%);
- Temperate (mean monthly temperature 25-30 and relative humidity <75%);
- Cold (mean monthly temperature <25 and relative humidity – can be any values);
- Composite (This applies when six months or more do not fall within any of the other categories meaning sharing characteristics of two or more of the above categories in a year).

Map of climatic zones is shown in Figure 3-7. The hot and dry zone lies in the western and the central parts of India; Jaisalmer, Jodhpur and Sholapur are some of the towns that experience this type of climate. In this zone, solar radiation and movement of hot winds are higher. The warm and humid zone covers the coastal parts of the country, such as Mumbai, Chennai and Kolkata. Pune and Bangalore are examples of non-coastal cities that fall the under moderate climatic zone. Generally, the Himalayan region experiences cold type of climate. The composite zone covers the northern Indo-Gangetic plains, such as New Delhi, Kanpur, and Allahabad.

With GIS overlay analysis, district overlap areas falling within each climatic zone have been computed. In order to compare impact of being a district in a climatic zone, district level ranking has been assigned based on the scheme shown in Table 3-2. District level climatic zone ranking for pilot states/ UT is shown in Table 3-3.

Hilly Areas and Building Class Zones

Extreme cold climate, rugged topography and use of flammable material in building construction (such as wood) and the use of heating provisions in houses during cold weather is an important factor for causing fire incidents in that region. To capture such elements in fire risk hazard, Hilly Areas and Building Class Zones have been created. This class is directly linked to the cold climate zone. All hilly districts, (such as all districts of Jammu & Kashmir in the Pilot study) fall under this category. In such districts, a ranking of five has been assigned. Importance of this zone in terms of occurrence of number of fire incidents is quite high. Hence, while integrating, a double weightage of 40% has been assigned to this layer.

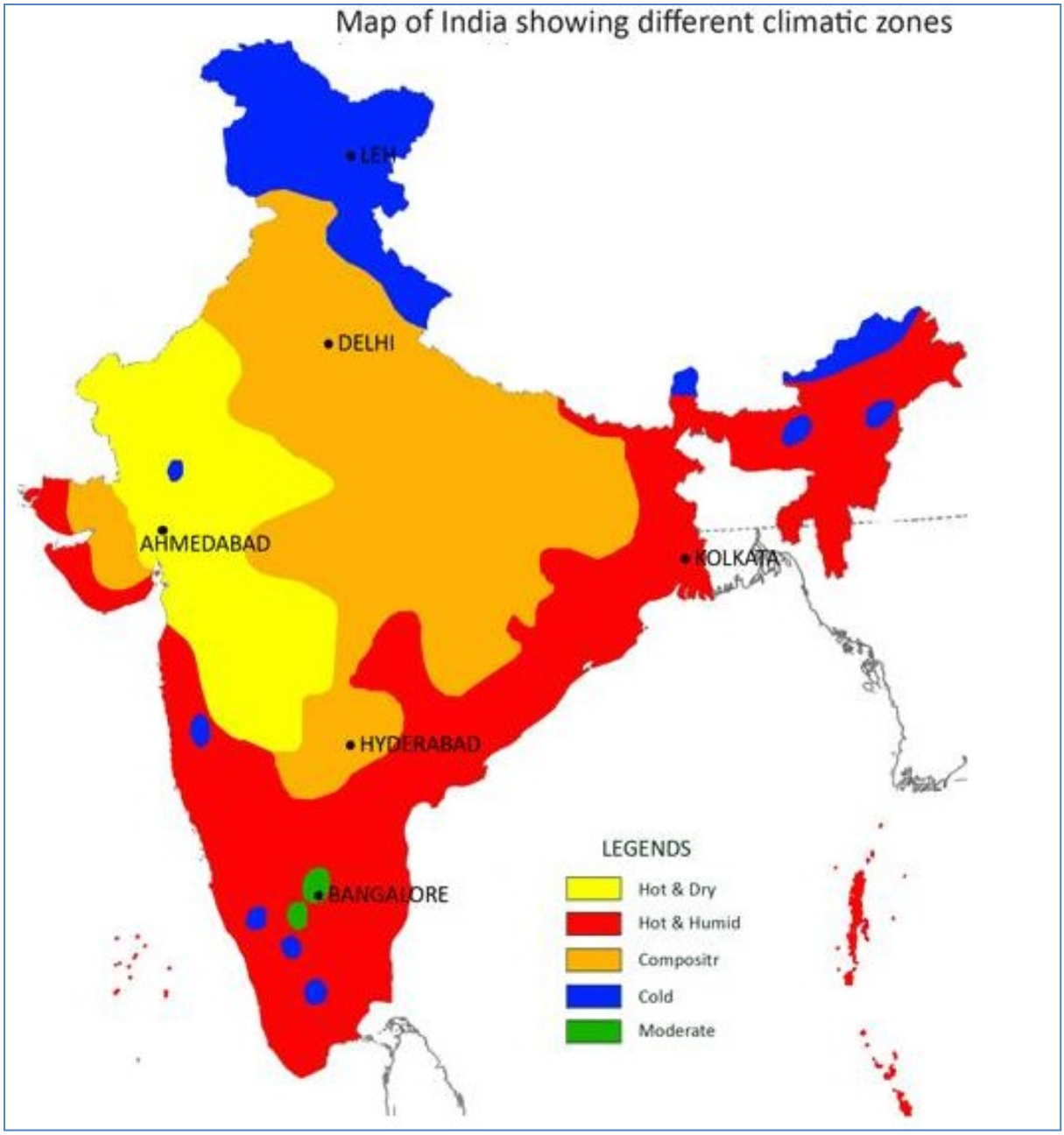


Figure 3-7 : Climatic Zones of India

Table 3-3: District level ranking for individual (earthquake, wind and climatic) hazard and integrated hazards

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/ UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate zoning	Hill zoning	
Jammu & Kashmir							
	Kupwara	2,857	3.0	3.0	1.0	5.0	3.4
	Badgam	1,163	3.0	3.4	1.0	5.0	3.5
	Leh (Ladakh)	80,271	1.1	3.0	1.0	5.0	3.0
	Kargil	14,847	2.2	3.0	1.0	5.0	3.2
	Punch	1,725	3.0	3.0	1.0	5.0	3.4
	Rajouri	2,415	3.0	3.0	1.0	5.0	3.4
	Kathua	2,731	3.0	3.0	2.0	4.0	3.2
	Baramula	2,045	3.0	3.0	1.0	5.0	3.4
	Bandipore	2,889	3.0	3.0	1.0	5.0	3.4
	Srinagar	463	3.0	4.0	1.0	5.0	3.6
	Ganderbal	1,449	3.0	3.4	1.0	5.0	3.5
	Pulwama	839	3.0	4.0	1.0	5.0	3.6
	Shupiyan	459	3.0	3.3	1.0	5.0	3.6
	Anantnag	2,743	3.0	3.8	1.0	5.0	3.6
	Kulgam	1,203	3.0	3.2	1.0	5.0	3.4
	Doda	2,360	3.0	3.0	0.2	5.0	3.2
	Ramban	1,021	3.0	3.0	1.0	5.0	3.4
	Kishtwar	7,916	3.0	3.3	1.0	5.0	3.5
	Udhampur	2,361	3.0	3.0	1.5	4.0	3.1
	Reasi	2,094	3.0	3.0	1.0	5.0	3.5
	Jammu	2,112	3.0	3.0	1.2	4.5	3.2
	Samba	854	2.9	3.0	2.0	4.0	3.2
Delhi							
	North West	449	4.5	2.4	2.0	1.0	2.2
	North	63	4.5	3.0	2.0	1.0	2.3
	North East	72	4.5	3.0	2.0	1.0	2.3
	East	66	4.5	3.0	2.0	1.0	2.3
	New Delhi	35	4.5	3.0	2.0	1.0	2.3
	Central	16	4.5	3.0	2.0	1.0	2.3
	West	116	4.5	2.7	2.0	1.0	2.2
	South West	411	4.5	2.7	2.0	1.0	2.2
	South	256	4.5	3.0	2.0	1.0	2.3
Rajasthan							
	Ganganagar	10,629	4.5	1.2	2.2	1.0	2.0
	Hanumangarh	9,992	4.5	1.0	2.0	1.0	1.9
	Bikaner	27,043	4.5	1.9	3.0	1.0	2.3
	Churu	17,098	4.5	1.1	2.4	1.0	2.0
	Jhunjhunun	5,904	4.5	1.0	2.0	1.0	1.9
	Alwar	8,317	4.5	1.9	2.0	1.0	2.1
	Bharatpur	5,082	4.5	2.4	2.0	1.0	2.2
	Dhaulpur	3,032	4.5	1.3	2.0	1.0	2.0
	Karauli	4,874	4.5	1.0	2.0	1.0	1.9
	Sawai Madhopur	5,024	4.5	1.0	2.0	1.0	1.9
	Dausa	3,555	4.5	1.2	2.0	1.0	1.9

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/ UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate zoning	Hill zoning	
	Jaipur	11,309	4.5	1.0	2.0	1.0	1.9
	Sikar	7,692	4.5	1.0	2.0	1.0	1.9
	Nagaur	17,710	4.5	1.0	2.6	1.0	2.0
	Jodhpur	22,903	4.5	1.2	3.0	1.0	2.1
	Jaisalmer	38,501	4.5	2.0	3.0	1.0	2.3
	Barmer	28,469	4.5	2.1	3.0	1.0	2.3
	Jalor	10,752	4.5	2.3	3.0	1.0	2.4
	Sirohi	5,169	4.5	2.1	1.7	1.0	2.0
	Pali	12,377	4.5	1.1	3.0	1.0	2.1
	Ajmer	8,537	4.5	1.0	2.6	1.0	2.0
	Tonk	7,256	4.5	1.0	2.3	1.0	2.0
	Bundi	5,825	4.5	1.0	2.9	1.0	2.1
	Bhilwara	10,477	4.5	1.0	3.0	1.0	2.1
	Rajsamand	4,683	4.5	1.0	3.0	1.0	2.1
	Dungarpur	3,794	3.0	1.8	3.0	1.0	1.9
	Banswara	4,315	3.0	1.2	3.0	1.0	1.8
	Chittaurgarh	7,882	4.5	1.0	3.0	1.0	2.1
	Kota	5,286	4.5	1.0	2.9	1.0	2.1
	Baran	6,834	4.5	1.0	2.9	1.0	2.1
	Jhalawar	6,270	4.5	1.0	3.0	1.0	2.1
	Udaipur	12,047	4.1	1.5	3.0	1.0	2.1
	Pratapgarh	4,259	4.2	1.0	3.0	1.0	2.0
Maharashtra							
	Nandurbar	5,915	3.0	2.0	3.0	1.0	2.0
	Dhule	7,197	3.0	2.0	3.0	1.0	2.0
	Jalgaon	11,805	3.0	1.5	3.0	1.0	1.9
	Buldana	9,775	3.0	1.1	3.0	1.0	1.8
	Akola	5,421	3.0	1.1	3.0	1.0	1.8
	Washim	5,212	3.0	1.0	3.0	1.0	1.8
	Amravati	12,244	3.0	1.6	2.7	1.0	1.9
	Wardha	6,326	3.6	1.0	2.0	1.0	1.7
	Nagpur	9,951	3.6	1.0	1.8	1.0	1.7
	Bhandara	4,090	3.7	1.0	1.3	1.0	1.6
	Gondiya	5,265	3.2	1.0	1.6	1.0	1.6
	Gadchiroli	14,486	3.9	1.4	1.1	1.0	1.7
	Chandrapur	11,334	4.0	1.5	1.0	1.0	1.7
	Yavatmal	13,566	3.4	1.0	2.2	1.0	1.7
	Nanded	10,623	3.1	1.0	2.5	1.0	1.7
	Hingoli	4,654	3.0	1.0	3.0	1.0	1.8
	Parbhani	6,406	3.0	1.0	3.0	1.0	1.8
	Jalna	7,706	3.0	1.0	3.0	1.0	1.8
	Aurangabad	10,234	3.0	1.3	3.0	1.0	1.8
	Nashik	15,599	3.0	2.0	2.8	1.0	2.0
	Thane	9,548	3.7	2.0	1.0	1.0	1.7
	Mumbai (Suburban)	454	4.0	2.0	1.0	1.0	1.8
	Mumbai	150	4.0	2.0	1.0	1.0	1.8
	Raigarh	7,060	3.9	2.8	1.0	1.0	1.9

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/ UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate zoning	Hill zoning	
	Pune	15,700	3.0	2.1	1.9	1.0	1.8
	Ahmadnagar	17,102	3.0	2.0	3.0	1.0	2.0
	Bid	10,597	3.0	1.6	3.0	1.0	1.9
	Latur	7,254	3.0	1.3	2.8	1.0	1.8
	Osmanabad	7,588	3.0	1.8	3.0	1.0	2.0
	Solapur	14,919	2.9	1.9	2.8	1.0	1.9
	Satara	10,605	2.8	2.5	0.7	3.0	2.4
	Ratnagiri	8,325	3.8	2.5	1.0	1.0	1.9
	Sindhudurg	5,107	3.0	2.0	1.0	1.0	1.6
	Kolhapur	7,683	2.8	2.0	1.0	1.0	1.6
	Sangli	8,527	2.5	2.0	1.0	1.0	1.5
Andaman & Nicobar Islands							
	Nicobars	1,579	4.0	4.0	1.0	1.0	2.2
	North & Middle Andaman	3,401	4.0	4.0	1.0	1.0	2.2
	South Andaman	2,425	4.0	4.0	1.0	1.0	2.2
Puducherry							
	Yanam	20.9	5.0	3.0	1.0	1.0	2.0
	Puducherry	312.8	5.0	2.0	1.0	1.0	1.8
	Mahe	8.6	3.0	2.0	1.0	1.0	2.2

3.5 Exposure Vulnerability Ranking

For estimating exposure and its vulnerability, detailed urban agglomerate classification maps generated from high-resolution satellite images have been used. With the help of remote sensing techniques applied on high-resolution satellite imageries, 10 types of urban agglomeration areas have been delineated (Figures 3-1 and 3-2). For major city areas, even more detailed urban agglomerate classification has been created with high-resolution data layers as shown in Figure 3-3. These include urban, semi-urban, building blocks, industrial and rural villages' built-up areas. District level census 2011 population has been distributed to each population agglomeration cluster. For exposure vulnerability, 4 different layers viz. population density, residential built-up areas, high-rise building block density, and industrial areas have been developed individually at district level. Table 3-4 shows district level geographical area, population, population density, residential built-up area, industrial area, and residential built-up area.

Table 3-4: District level geographical area, population, population density, residential built-up area, residential built-up area, and industrial area

DISTRICT		Geographical Area (sq km)	Population 2011	Population Density	Residential Built--Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Jammu & Kashmir							
	Kupwara	2,857	875,564	306.42	41.29	0.099	1.4%
	Badgam	1,163	735,753	632.74	59.91	0.374	5.2%

DISTRICT		Geographical Area (sq km)	Population 2011	Population Density	Residential Built--Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
	Leh (Ladakh)	80,271	147,104	1.83	34.96	0.011	0.0%
	Kargil	14,847	143,388	9.66	6.52	0	0.0%
	Punch	1,725	476,820	276.42	5.84	0	0.3%
	Rajouri	2,415	619,266	256.4	8.42	0.167	0.3%
	Kathua	2,731	615,711	225.49	32.82	1.033	1.2%
	Baramula	2,045	1,015,503	496.55	73.73	0.247	3.6%
	Bandipore	2,889	385,099	133.28	19.95	0.026	0.7%
	Srinagar	463	1,269,751	2,743.04	67.39	1.056	14.6%
	Ganderbal	1,449	297,003	205.01	26.12	0.054	1.8%
	Pulwama	839	570,060	679.69	37.73	0.783	4.5%
	Shupiyan	459	265,960	579.56	13.9	0	3.0%
	Anantnag	2,743	1,070,144	390.19	21.36	0.011	0.8%
	Kulgam	1,203	422,786	351.47	13.39	0	1.1%
	Doda	2,360	409,576	173.57	8.14	0	0.3%
	Ramban	1,021	283,313	277.49	4.33	0.058	0.4%
	Kishtwar	7,916	231,037	29.19	8.65	0	0.1%
	Udhampur	2,361	555,357	235.19	25.17	0.211	1.1%
	Reasi	2,094	314,714	150.27	5.98	0.017	0.3%
	Jammu	2,112	1,526,406	722.87	127.78	1.767	6.1%
	Samba	854	318,611	373.04	23	4.203	2.7%
Delhi							
	North West	449	3,651,261	8,133.80	84.34	14.051	18.8%
	North	63	883,418	14,044.80	27.8	1.065	44.2%
	North East	72	2,240,749	31,208.20	29.75	1.387	41.4%
	East	66	1,707,725	25,913.88	28.8	1.167	43.7%
	New Delhi	35	133,713	3,798.66	12.48	0.941	35.4%
	Central	16	578,671	35,720.43	9.13	0.732	56.3%
	West	116	2,531,583	21,918.47	54.96	2.999	47.6%
	South West	411	2,292,363	5,574.81	75.15	5.497	18.3%
	South	256	2,733,752	10,682.89	67.47	5.073	26.4%
Rajasthan							
	Ganganagar	10,629	1,969,520	185.3	225.55	5.248	2.1%
	Hanumangarh	9,992	1,779,650	178.11	210.24	2.394	2.1%

DISTRICT		Geographical Area (sq km)	Population 2011	Population Density	Residential Built--Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
	Bikaner	27,043	2,367,745	87.56	256.36	6.163	0.9%
	Churu	17,098	2,041,172	119.38	222.78	0.9	1.3%
	Jhunjhunun	5,904	2,139,658	362.38	113.58	1.49	1.9%
	Alwar	8,317	3,671,999	441.53	141.81	16.816	1.7%
	Bharatpur	5,082	2,549,121	501.56	77.61	1.504	1.5%
	Dhaulpur	3,032	1,207,293	398.13	34.28	0.851	1.1%
	Karauli	4,874	1,458,459	299.24	41.35	0.941	0.8%
	Sawai Madhopur	5,024	1,338,114	266.32	63.89	0.257	1.3%
	Dausa	3,555	1,637,226	460.61	38.67	1.565	1.1%
	Jaipur	11,309	6,663,971	589.28	321.85	24.65	2.8%
	Sikar	7,692	2,677,737	348.12	133.44	1.452	1.7%
	Nagaur	17,710	3,309,234	186.85	200.54	2.054	1.1%
	Jodhpur	22,903	3,685,681	160.93	253.18	33.099	1.1%
	Jaisalmer	38,501	672,008	17.45	128.08	2.259	0.3%
	Barmer	28,469	2,604,453	91.48	133.66	2.973	0.5%
	Jalor	10,752	1,830,151	170.22	93.81	1.212	0.9%
	Sirohi	5,169	1,037,185	200.65	51.49	3.97	1.0%
	Pali	12,377	2,038,533	164.7	134.53	5.28	1.1%
	Ajmer	8,537	2,584,913	302.79	134.51	6.86	1.6%
	Tonk	7,256	1,421,711	195.94	75.15	0.778	1.0%
	Bundi	5,825	1,113,725	191.2	49.99	0.939	0.9%
	Bhilwara	10,477	2,410,459	230.07	101.97	7.489	1.0%
	Rajsamand	4,683	1,158,283	247.34	35.86	11.386	0.8%
	Dungarpur	3,794	1,388,906	366.05	25.83	0.791	0.7%
	Banswara	4,315	1,798,194	416.72	15.56	1.347	0.4%
	Chittaurgarh	7,882	1,544,392	195.94	68.27	7.234	0.9%
	Kota	5,286	1,950,491	369.02	128.25	13.15	2.4%
	Baran	6,834	1,223,921	179.09	109.92	3.318	1.6%
	Jhalawar	6,270	1,411,327	225.11	151.94	7.328	2.4%
	Udaipur	12,047	3,067,549	254.64	115.26	14.086	1.0%
	Pratapgarh	4,259	868,231	203.86	20.59	0.245	0.5%
Maharashtra							
	Nandurbar	5,915	1,646,177	278.31	73.93	2.269	1.2%

DISTRICT	Geographical Area (sq km)	Population 2011	Population Density	Residential Built--Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Dhule	7,197	2,048,781	284.69	78.64	4.806	1.1%
Jalgaon	11,805	4,224,442	357.86	163.81	5.534	1.4%
Buldana	9,775	2,588,039	264.75	96.47	2.766	1.0%
Akola	5,421	1,818,617	335.48	76.58	4.784	1.4%
Washim	5,212	1,196,714	229.62	44.92	0.881	0.9%
Amravati	12,244	2,887,826	235.86	150.26	5.335	1.2%
Wardha	6,326	1,296,157	204.9	64.9	2.857	1.0%
Nagpur	9,951	4,653,171	467.63	152.02	20.136	1.5%
Bhandara	4,090	1,198,810	293.11	49.41	0.728	1.2%
Gondiya	5,265	1,322,331	251.18	77.26	2.616	1.5%
Gadchiroli	14,486	1,071,795	73.99	128.39	1.108	0.9%
Chandrapur	11,334	2,194,262	193.59	112	5.901	1.0%
Yavatmal	13,566	2,775,457	204.6	129.66	5.239	1.0%
Nanded	10,623	3,356,566	315.98	100.94	2.479	1.0%
Hingoli	4,654	1,178,973	253.35	36.22	0.791	0.8%
Parbhani	6,406	1,835,982	286.63	48.35	1.636	0.8%
Jalna	7,706	1,958,483	254.16	66.94	3.231	0.9%
Aurangabad	10,234	3,695,928	361.14	141.75	15.032	1.4%
Nashik	15,599	6,109,052	391.62	239.08	25.156	1.5%
Thane	9,548	11,054,131	1,157.79	229.74	29.643	2.4%
Mumbai (Suburban)	454	9,332,481	20,560.65	104.57	7.761	23.0%
Mumbai	150	3,145,966	21,015.14	29.54	5.304	19.7%
Raigarh	7,060	2,635,394	373.29	71.39	14.23	1.0%
Pune	15,700	9,426,959	600.43	370.39	53.713	2.4%
Ahmadnagar	17,102	4,543,083	265.64	307.21	11.609	1.8%
Bid	10,597	2,585,962	244.02	88.82	1.882	0.8%
Latur	7,254	2,455,543	338.49	116.01	6.81	1.6%
Osmanabad	7,588	1,660,311	218.82	89.13	1.871	1.2%
Solapur	14,919	4,315,527	289.27	231.79	9.434	1.6%
Satara	10,605	3,003,922	283.25	206.87	3.688	2.0%
Ratnagiri	8,325	1,612,672	193.71	94.82	1.915	1.1%
Sindhudurg	5,107	848,868	166.23	69.57	1.491	1.4%
Kolhapur	7,683	3,874,015	504.22	196.89	10.018	2.6%

DISTRICT		Geographical Area (sq km)	Population 2011	Population Density	Residential Built--Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
	Sangli	8,527	2,820,575	330.8	141.53	6.334	1.7%
Andaman & Nicobar Islands							
	Nicobars	1,579	36,819	23.32	3.8	0	0.2%
	North & Middle Andaman	3,401	105,539	31.03	20.17	0	0.6%
	South Andaman	2,425	237,586	97.98	19.53	0.121	0.8%
Puducherry UT							
	Karaikal	160.3	200,314	1,255.43	23.07	0.76	14.4%
	Yanam	20.9	55,616	1,853.87	4.01	0.75	13.4%
	Puducherry	312.8	946,600	3,038.94	31.67	1.76	10.2%
	Mahe	8.6	41,934	4,659.33	1.02	0.35	11.4%

In order to assess the impact of each exposure vulnerability type, a vulnerability score/ ranking has been assigned to each layer at its base unit. The vulnerability score represents the level of vulnerability (very high to negligible) of a specific type of exposure in response to the occurrences of small and medium fire incidents. Base unit for vulnerability ranking is the district boundary. The natural break in value distribution has been considered for defining the ranking class.

Based on Census 2011 population, district-level population densities have been computed and grouped into five ranges based on the schema shown in Table 3-5. A ranking of 5 has been assigned to highly dense districts, having populations greater than 10,000 per sq km, and 1 to sparsely populated districts having less than 200 people per sq km area.

Table 3-5: Grouping schema for ranking of exposure and vulnerability layers

Population density	Ranking
>10,000	5
1,000 to 10,000	4
500 to 1,000	3
200 to 500	2
<200	1

Built-up area %	Ranking
>35 %	5
14% to 35 %	4
2% to 14 %	3
1% to 2 %	2
<1 %	1

Residential Built-up area sq km	Ranking
>190	5
100 to 190	4
50 to 100	3
20 to 50	2
<20	1

Industrial area sq km	Ranking
>10	5
5 to 10	4
2 to 5	3
1 to 2	2
< 1	1

As described earlier, various types of residential built-up areas have been delineated using high-resolution images. For assessing fire risk, both absolute built-up areas in sq km as well as built-up areas percent (ratio of built-up areas to the total area) are important parameters. Figure 3-8 illustrates an example of district level ranking of residential built-up area percent and corresponding residential built up area in absolute terms (i.e. area in sq.km.). In Maharashtra, Pune district has the highest residential built-up area, while in terms of residential built-up area in percentage, Pune district comes at fifth rank (Figure 3-8).

District level values of residential built-up area in percent and in absolute terms (i.e. area in sq km.) has been grouped separately into five classes and assigned a ranking score of 1- 5 based on the schema shown in Table 3-5. Districts having > 35% residential built-up have been assigned 5th ranking, while districts having <1 % built-up area as whole have been assigned a rank of 1. In pilot states and UT, about one-third (34%) districts fall in rank 1. Similarly, 5 ranking has been assigned to district wise residential built-up areas in sq km based on schema shown in Table 3-5. This schema has been prepared based on natural breaks of value distribution considering all 106 districts of the pilot study area.

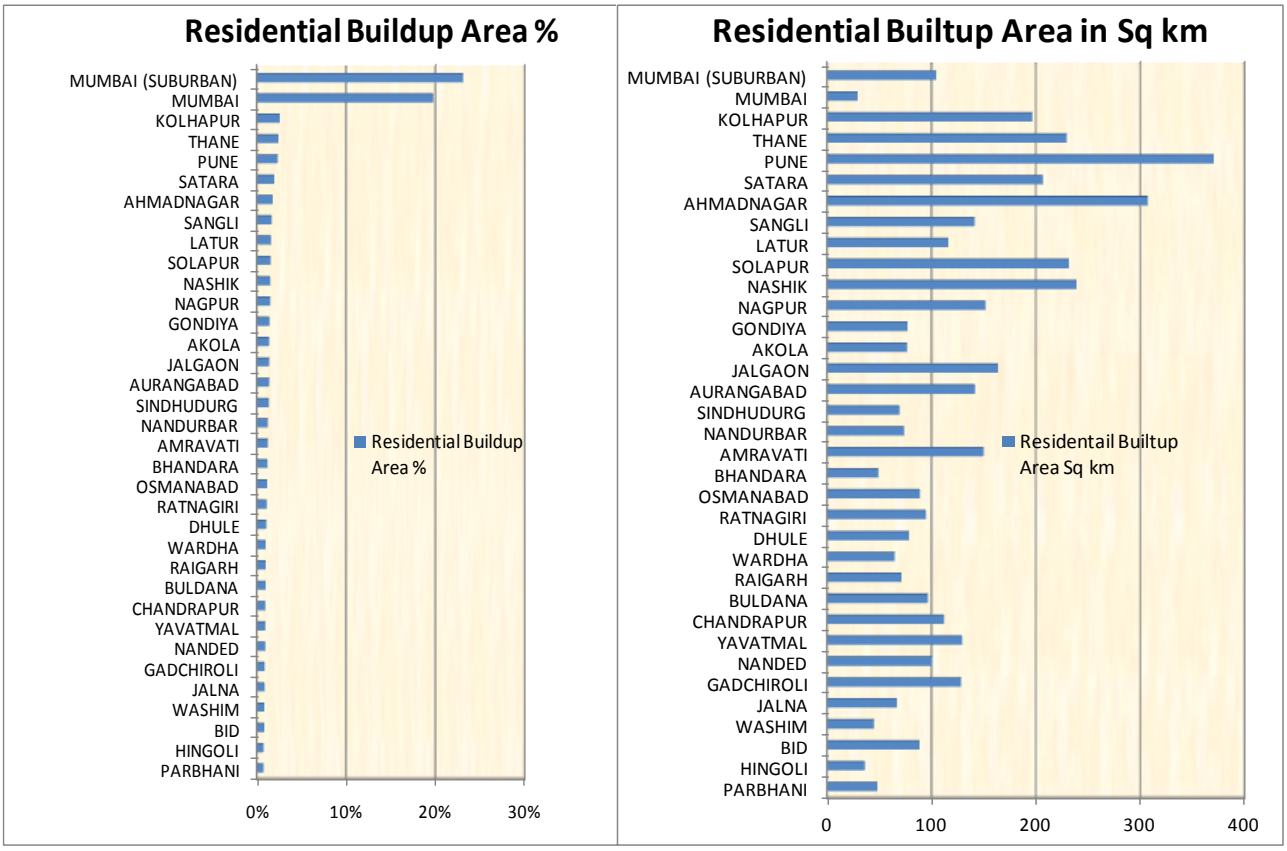


Figure 3-8 : Comparisons of district level ranking for residential built-up area percentages and absolute areas (in sq km) for all 35 districts of Maharashtra state

It is obvious that industrial areas in districts have much lower percentages than residential built-up areas. However, presence of industrial areas in a district has a significant influence in assessing fire risk. Hence, industrial areas in absolute terms (sq km) have been considered in risk ranking. In a similar fashion, district wise industrial areas have been grouped into five classes and vulnerability ranking has been assigned based on the schema described in Table 3-5. Districts having more than 10 sq km industrial plot area are ranked at 5, while districts having industrial area of less than 1 sq km are ranked at 1 (Table 3-5).

District level total residential built-up areas in sq km and industrial areas for all 35 districts of Maharashtra have been plotted for direct comparison in Figure 3-9. Industrial as well residential built-up area is the highest in Pune district. In contrast, Ahmadnagar, has second ranking in terms of residential built-up area, but in terms of industrial area, Thane district holds second ranking (Figure 3-9).

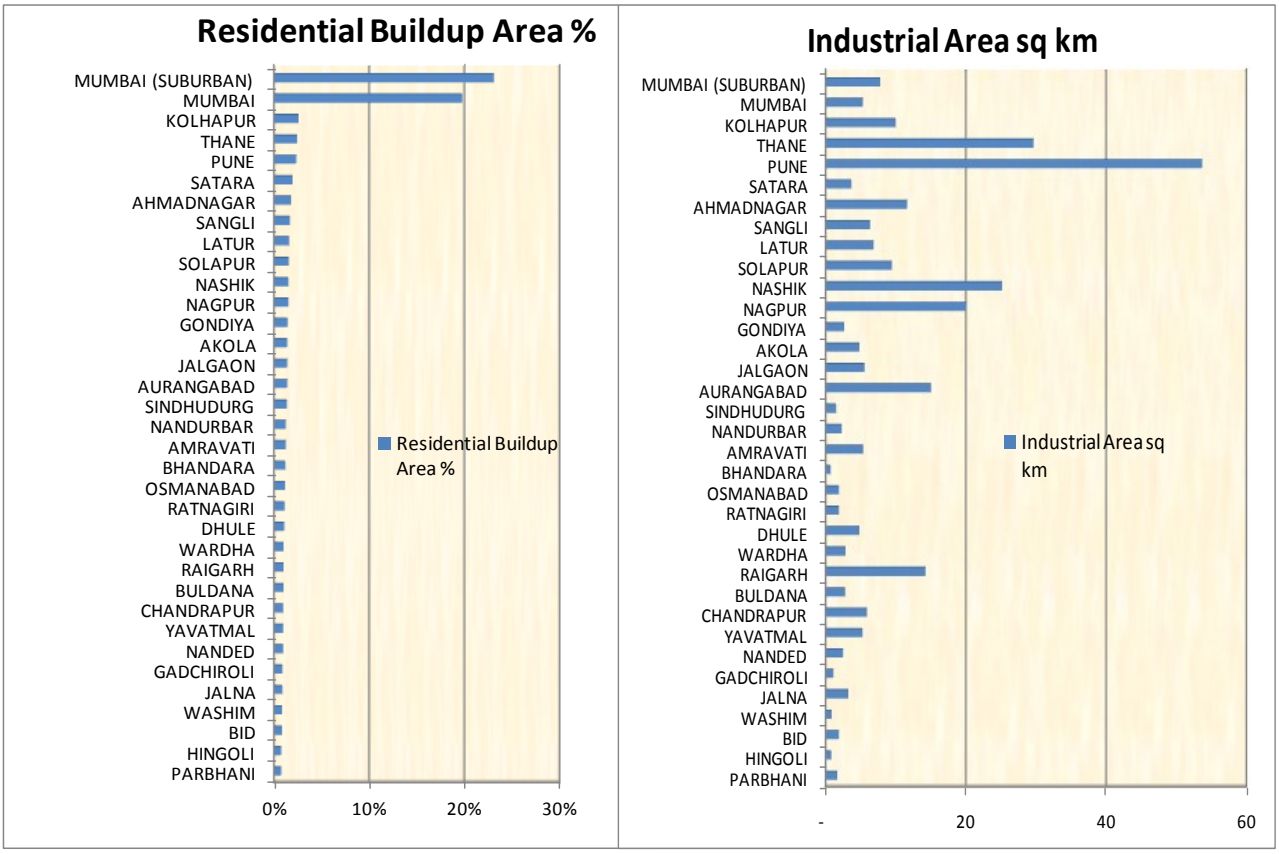


Figure 3-9 : Comparison of district level ranking for residential built-up areas and industrial areas (in sq km) for all 35 districts of Maharashtra state

Integrated Risk Analysis

After developing ranking of individual units in terms of hazard and exposure vulnerability, GIS layers have been overlaid on top of each other and a spatial analysis has been performed for integration in GIS environment. For combining hazard and risk, Weighted Factor Analysis (WFA) in GIS environment has been performed. Weighted ranking scores have been used in the integration analysis and quantified risk distribution for all districts. Values of weighted factor depend upon the importance of a particular hazard/ vulnerability class in risk analysis. For example, temperate zone hazard value of a district has a much lower weight than the population density of a district.

For integration of hazards, equal weights have been assigned to wind, seismic, and climatic hazards, while double weights have been given to hill zoning (Table 3-5). This is because, in hilly terrain, wooden houses, and heating provisions in buildings increase the chances of fire-incidences, and thus have been given higher weightage.

Four layers of exposure/ vulnerability, such as population density, residential built-up area percentage, residential built-up area in sq km and Industrial area in sq km seem to have equal importance in the occurrence of the number of fire incidents in a district. Hence, equal weights have been assigned in integration of these layers (Table 3-6).

After obtaining integrated individual weighted score for hazard and exposure vulnerability, fire risk categories have been obtained in quantitative terms by further integration of hazard and exposure vulnerability. It is obvious that in the occurrence of the number of fire incidents in a given district, exposure vulnerability has more importance than the prevailing hazard. Hence, in quantified integration, double weights have been assigned to exposure vulnerability (Table 3-6).

Table 3-6: Weightage assigned in risk scoring schema for integration of hazard and exposure vulnerability into fire risk categories

Hazard		Weightage	
H1	Wind Zoning	W1	0.2
H2	Seismic Zoning	W2	0.2
H3	Climate zoning	W3	0.2
H4	Hill zoning	W4	0.4
Integrated Hazard		H1*W1+H2*W2+H3*W3+H4*W4	

Exposure/ Vulnerability Class		Weightage	
EV1	Population Density	W1	0.25
EV2	Residential built-up area %	W2	0.25
EV3	Residential built-up area in sq km	W3	0.25
EV4	Industrial area in sq km	W4	0.25
Integrated Exposure Vulnerability		EV1*W1+EV2*W2+EV3*W3+EV4*W4	

Fire Risk score = Integrated Hazard x 2 (Integrated Exposure Vulnerability)

The quantified numeric values of district risk scores are again grouped into four descriptive categories of district level risk ranking (very high, high, medium, and low) as depicted in Table 3-7.

Table 3-7: Districts risk ranking for all pilot States/UTs

DISTRICT	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
Jammu & Kashmir						
Kupwara	2	2	2	1	6.9	Medium
Badgam	3	3	3	1	8.5	High
Leh (Ladakh)	1	2	1	1	5.5	Low
Kargil	1	1	1	1	5.2	Low
Punch	2	1	1	1	5.9	Low
Rajouri	2	1	1	1	5.9	Low
Kathua	2	2	2	2	7.2	Medium
Baramula	3	3	3	1	8.4	High
Bandipore	1	2	1	1	5.9	Low
Srinagar	4	3	4	2	10.1	Very high
Ganderbal	2	2	2	1	7.0	Medium
Pulwama	3	2	3	1	8.1	Medium
Shupiyan	3	1	3	1	7.5	Medium

DISTRICT	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
Anantnag	2	2	1	1	6.6	Low
Kulgam	2	1	2	1	6.4	Low
Doda	1	1	1	1	5.4	Low
Ramban	2	1	1	1	5.9	Low
Kishtwar	1	1	1	1	5.5	Low
Udhampur	2	2	2	1	6.6	Medium
Reasi	1	1	1	1	5.4	Low
Jammu	3	4	3	2	9.2	Very high
Samba	2	2	3	3	8.4	High
Delhi						
North West	4	3	4	5	10.2	Very high
North	5	2	5	2	9.3	Very high
North East	5	2	5	2	9.3	Very high
East	5	2	5	2	9.3	Very high
New Delhi	4	1	5	1	7.8	High
Central	5	1	5	1	8.3	High
West	5	3	5	3	10.2	Very high
South West	4	3	4	4	9.7	Very high
South	5	3	4	4	10.3	Very high
Rajasthan						
Ganganagar	1	5	3	4	8.5	Very high
Hanumangarh	1	5	3	3	7.9	High
Bikaner	1	5	1	4	7.8	High
Churu	1	5	2	1	6.5	Medium
Jhunjhunun	2	4	2	2	6.9	Medium
Alwar	2	4	2	5	8.6	Very high
Bharatpur	3	3	2	2	7.2	Medium
Dhaulpur	2	2	2	1	5.5	Low
Karauli	2	2	1	1	4.9	Low
Sawai Madhopur	2	3	2	1	5.9	Medium
Dausa	2	2	2	2	5.9	Medium
Jaipur	3	5	3	5	9.9	Very high
Sikar	2	4	2	2	6.9	Medium
Nagaur	1	5	2	3	7.5	High
Jodhpur	1	5	2	5	8.6	Very high
Jaisalmer	1	4	1	3	6.8	Medium
Barmer	1	4	1	3	6.8	Medium
Jalor	1	3	1	2	5.9	Low
Sirohi	2	3	2	3	7	Medium
Pali	1	4	2	4	7.6	High
Ajmer	2	4	2	4	8	High
Tonk	1	3	2	1	5.5	Low
Bundi	1	3	1	1	5.1	Low
Bhilwara	2	4	1	4	7.6	High

DISTRICT	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
Rajsamand	2	2	1	5	7.1	Medium
Dungarpur	2	2	1	1	4.9	Low
Banswara	2	1	1	2	4.8	Low
Chittaurgarh	1	3	1	4	6.6	Medium
Kota	2	4	3	5	9.1	Very high
Baran	1	4	2	3	7.1	Medium
Jhalawar	2	4	3	4	8.6	Very high
Udaipur	2	4	1	5	8.1	High
Pratapgarh	2	2	1	1	5	Low
Maharashtra						
Nandurbar	2	3	2	3	7	Medium
Dhule	2	3	2	3	7	Medium
Jalgaon	2	4	2	4	7.9	High
Buldana	2	3	1	3	6.3	Medium
Akola	2	3	2	3	6.8	Medium
Washim	2	2	1	1	4.8	Low
Amravati	2	4	2	4	7.9	High
Wardha	2	3	2	3	6.7	Medium
Nagpur	2	4	2	5	8.2	High
Bhandara	2	2	2	1	5.1	Low
Gondiya	2	3	2	3	6.6	Medium
Gadchiroli	1	4	1	2	5.7	Low
Chandrapur	1	4	1	4	6.7	Medium
Yavatmal	2	4	1	4	7.2	Medium
Nanded	2	4	1	3	6.7	Medium
Hingoli	2	2	1	1	4.8	Low
Parbhani	2	2	1	2	5.3	Low
Jalna	2	3	1	3	6.3	Medium
Aurangabad	2	4	2	5	8.3	High
Nashik	2	5	2	5	9	Very high
Thane	4	5	3	5	10.2	Very high
Mumbai (Suburban)	5	4	4	4	10.3	Very high
Mumbai	5	2	4	4	9.3	Very high
Raigarh	2	3	2	5	7.9	High
Pune	3	5	3	5	9.8	Very high
Ahmadnagar	2	5	2	5	9	Very high
Bid	2	3	1	2	5.9	Medium
Latur	2	4	2	4	7.8	High
Osmanabad	2	3	2	2	6.5	Medium
Solapur	2	5	2	4	8.4	Very high
Satara	2	5	2	3	8.4	High
Ratnagiri	1	3	2	2	5.9	Low
Sindhudurg	1	3	2	2	5.6	Low

DISTRICT	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
Kolhapur	3	5	3	5	9.6	Very high
Sangli	2	4	2	4	7.5	High
Andaman & Nicobar Islands						
Nicobars	1	1	1	1	4.2	Low
North & Middle Andaman	1	2	1	1	4.7	Low
South Andaman	1	2	1	1	4.7	Low
Puducherry UT						
Yanam	4	1	4	1	7.2	Medium
Puducherry	4	2	4	2	8	High
Mahe	4	1	4	1	6.6	Medium
Karaikal	4	2	4	1	7.3	Medium

4 Field Surveys of Fire Stations for Data Collection

At present, there is a lack of a comprehensive centralized database on the distribution of fire service infrastructure, and the stock of existing firefighting vehicles, manpower and specialized equipments, their types, and their quantities. Most of the information is either disaggregated or not updated. This information is required for undertaking the gap analysis, future planning, and improvement of Institutional Capacity, Financial Planning, and creating a roadmap for the next 10 years for Revamping the Fire Services in the country. To have first-hand information on the distribution of the fire service stations across the country, trained human resources, infrastructure availability and their status, RMSI project team has carried out surveys of Fire Stations and collected data from Headquarters of all the states under the jurisdiction of DG, NDRF & CD (Fire) in the country. In addition to the survey of Fire Stations, the team has also collected the location (latitude, longitude) of Fire Stations using GPS. The geographical coordinate information is used for plotting all the Fire Station locations on the map to perform GIS based spatial analysis. This is required for the analysis of distribution of Fire Stations and gap analysis on fire-infrastructure, based on risk-category, response time, and population.

4.1 Field-Survey of individual Fire Station and collection of Headquarter Data

RMSI project team has designed a comprehensive “Fire Headquarter Data Collection Form” (*Annexure-1*) and individual “Fire Station Survey Form” (*Annexure-2*) to collect all the required information for each State/UT in the country.

The information includes but is not limited to:

i. Location (latitude, longitude) and location description of the Fire Station

ii. Name of fire-station in-charge and his contact details

iii. Fire Vehicles type, numbers, their model, year of manufacture/induction at the Fire Station, and general condition of fire vehicles

iv. Specialized firefighting equipment, their type, and quantity

v. Road access and connectivity to vulnerable areas

vi. Infrastructure facilities (accommodation) of fire-personnel and their distance from Fire Stations

vii. Duty patterns

viii. Staff details at different levels

ix. Water availability etc.

The Fire Headquarter Data Collection Form and individual Fire Station Survey Form have been designed in such a way as to extract most of the common information including communication, human resources, specialized equipments, fire-statistics etc. applicable for the entire State, in a quantitative way, which might help the analysis at a later stage. In addition to infrastructure information, RMSI also attempted to collect information/indicators related to vulnerability and risk through indirect questions like:

i. Year wise information on the number of events each unit had attended during the last 5 years and losses caused by fire events both in terms of assets and life.

ii. Few questions on the general perception of the fire officer and in charge of the unit on various types of risks in the Fire Station jurisdiction.

Analysis on the information of events over time and the loss can provide an understanding of the vulnerability and risk as well as the susceptibility trend over the year. The fire officer would be the key person who faces actual needs on the ground as well as in using the infrastructure for the service.

During the field survey in the pilot study, the RMSI team members have interacted with Fire Station In-charges to gather the required information. In addition to discussions with the Fire Station in charge, other key department officials have been contacted to know their perception about the fire risks and the difficulties that fire department is facing. The project team is ensuring that the Headquarter Data Collection Forms and Individual Fire Station Survey Forms are comprehensive and contain all information required for this assignment.

The field data collected by the survey team have undergone through quality checks and the project team has created a database with all collected information. The database has been designed in such a way that the data can be used for spatial and non-spatial analysis. All the Fire Stations have a unique code as identifier.

4.2 Stakeholder Analysis

Apart from the quantitative data collection on the distribution of fire service infrastructure, stock of the existing equipments and their quality, the RMSI team also interacted with some of the key fire officials and senior members in DGCD, MHA and NDRF. The focus of such discussions was more on institutional aspects (issues in the service delivery and suggestions), capacity, and future requirements. As these interactions are mostly with senior personnel of fire department, the focus has been to derive a broader picture in terms of requirements, investment, and institutional capacity building. This information has been compiled and summarized under various heads, for instance, requirement, investment, institutional capacity building, etc. RMSI key experts have been analyzing the diverse opinion of various fire officials and are providing their recommendations.

Any significant issue that was observed during this process, in terms of issues in the process of the delivery/bottlenecks in smooth operation had been highlighted along with RMSI's suggested solution.

In case required, as a last stage of the stakeholder analysis, RMSI will hold discussions with officials of the DG NDRF & CD to present the summary of observations for discussion as a close-door meeting by inviting only some of the identified senior personnel. By presenting this perception report collected from various States in a concise manner, RMSI expect a brain-storming session to get some concrete recommendation, which will be in line with various policy matters of the department.

5 Development of Fire Decision Support System (FDSS)

This chapter discusses the modeling software solution named FDSS (Fire Decision Support System), developed as part of the deliverables. FDSS is a dynamic web-based application aimed at supporting decision makers take optimal decisions on complex tasks, such as resource prepositioning, gap analysis, prioritization, and resource optimization along with the day-to-day tasks. The most important aspect of FDSS is that it enables the apex fire management authority to provide the entire country's fire agencies information on a single platform.

5.1 Salient Features

Following is a brief description of the FDSS platform. The platform is built on a framework that is state of the art and is the most suitable solution for users' needs.

The salient features of the FDSS platform include:

- Web based application built using .NET Framework 3.5 utilizing the GIS capabilities of an open source GIS Platform.
- Multi-tier system architecture that follows the Object Oriented Programming model with the following objectives:
    - Loose coupling between the various tiers – presentation, business and data
    - Ease of development and deployment
- Ability to navigate, query and render the spatial data
- Exposure view, query and update capabilities that will help the user to keep the information in the system up-to-date
- Ability to view and query the outputs in a tabular format
- A powerful reporting engine that enables a set of pre-formatted reports that provide various views of the outputs from the model
- A thematic map generator that uses the underlying GIS platform to depict the outputs from the model as pre-designed thematic maps.

5.2 High Level Design

FDSS has a multi-tier architecture to allow for modularity and scalability. The architecture follows the Object Oriented Programming model. The various tiers of the system are as shown in Figure 5-1.

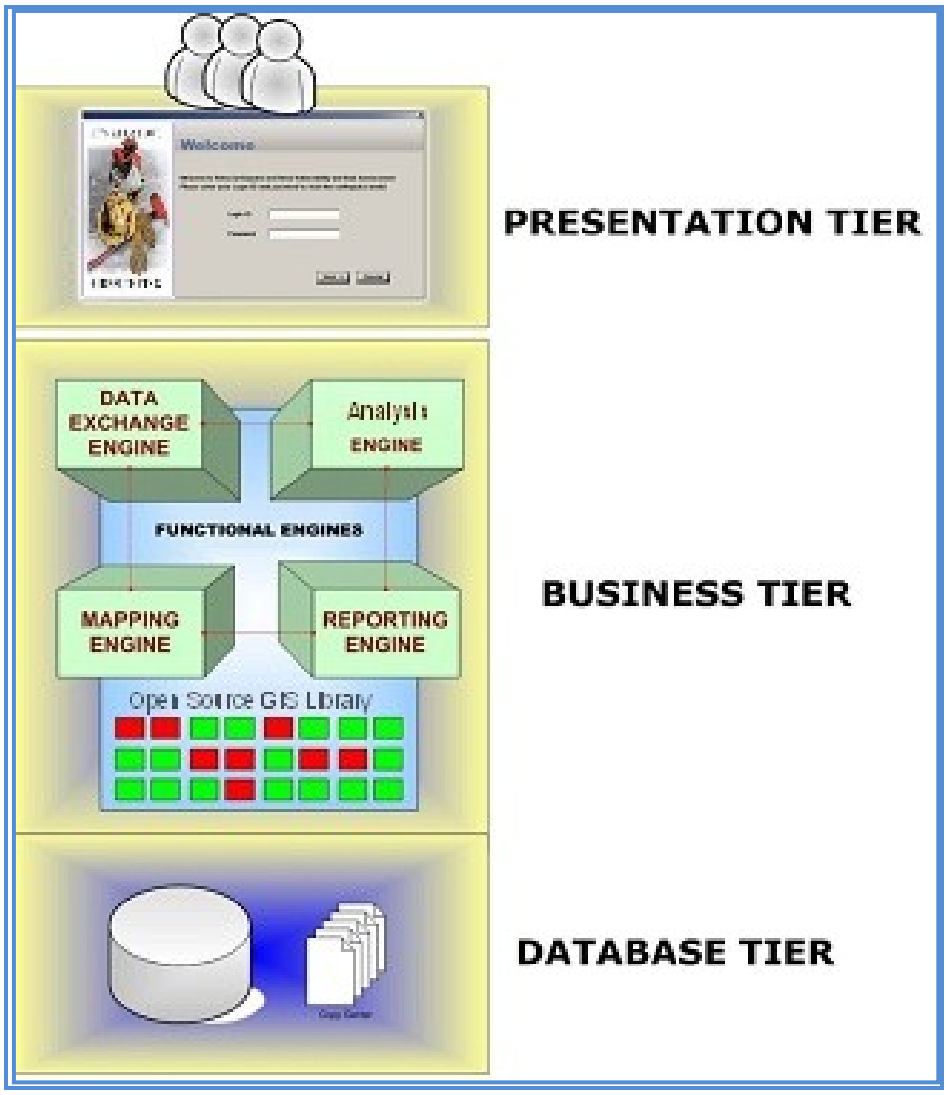


Figure 5-1 : Three-tier architecture

- **Presentation tier:** This user interface is responsible for gathering inputs from the user and passing on the same to the business layer for processing. The presentation layer ensures that the communications passing through are in the appropriate form for the recipient business objects in the business tier. In FDSS, the user interface constitutes this tier.
- **Business tier:** consists of the system business rules and computing logic as a set of business objects. This tier also interfaces with the data tier. The Mapping engine, Data Access engine, Reporting engine, and Analysis engine constitute this tier.
- **Database tier:** consists of the environment that allows persistence of user information – both lookup and computed data. Physical implementation of this layer can be files on the system or databases. In FDSS, relational database constitutes this tier and houses both spatial and non-spatial data.

Figure 5-2 shows the high-level design for the FDSS platform. The whole architecture is modular. The major modules are user Data Warehouse, Platform Components, and User Interface. The model components are stand-alone and are not dependent on the platform

components. Both perform their respective tasks working with the same data on the backend and are guided by the same user interface on the front end. The following sections discuss the various modules in detail and showcase how all the requirements are delivered by the FDSS platform.

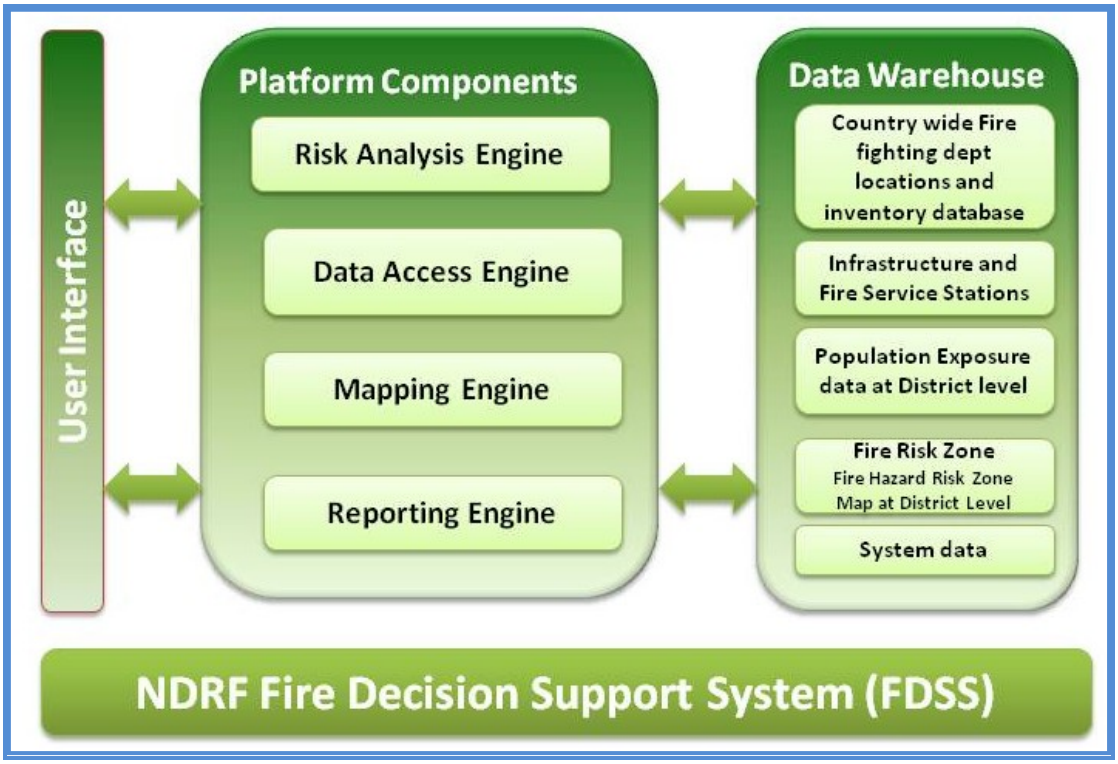


Figure 5-2 : High level design of FDSS

5.2.1 DATA WAREHOUSE

Data warehouse represents the Database tier. It stores all the input data to the model, system data, and the output results. The data can be categorized as spatial and non-spatial. All the spatial data resides either in the form of ESRI shape files and grids or Postgres based PostGIS database. Post GIS/ Postgres is an open source geo-spatial relational database system. All the non-spatial data is stored as tables in the Postgres database.

Spatial Data Layers: The spatial data layers stored in the data warehouse are:

- Fire Station locations and inventory data at Fire Station level
- Land Use Land Cover classes by their use or occupancy
- Fire Risk Zone Map at district level
- Population density map at district level
- Road and Rail Network

5.3 Platform Components

Platform components represent the Application Tier. These components focus on the application logic for all data access, mapping and reporting. These are generic components

that operate directly on the data warehouse and present the data in different views to the user.

Data Access Engine: Data Access Engine provides access to all non-spatial data that are stored in the Data Warehouse. This includes data viewing and editing capabilities. This allows for bulk building inventory updates and extraction of results so the outcome of the analysis can be reused for other applications.

Mapping Engine: Mapping engine provides all mapping capabilities to the application. The major component in mapping engine is the Map Viewer that loads the spatial data and displays the map and provides all basic map navigation functions like Zoom, Pan, Identify tool and calculate distance. This engine also provides spatial querying capabilities like buffer query and point in polygon query. In addition to this, the mapping engine also provides capabilities for defining symbology for various map layers including themes based on a range of values and unique values. All the layers are loaded with a predefined symbology. The mapping engine provides the ability to view the hazard, damage and loss on maps using predefined themes based on a range of values.

Reporting Engine: Reporting engine generates all the reports. FDSS provides a set of preformatted predefined reports that can be printed or exported into Excel format. This provides the ability to format the data into tables, generate summations, and create graphs. The following reports are generated at district and state levels by the reporting engine:

- Infrastructure Report
- Gap Analysis Report
- Status report for individual Fire Stations, district and state levels for and other reports required for decision making

The FDSS provides functionality to run GAP Analysis at two levels:

- State
- District

This system provides the option for running gap analysis for firefighting and rescue vehicles, specialized equipment, firefighting manpower, building infrastructure. User can also opt to get output based on all the analysis parameters available.

User Interface: User Interface (Figure 5-3) comprises of the Presentation tier. This is the part of the FDSS platform that the user interacts with. User Interface for FDSS can be categorized into two types:

1) System Administration Interface
2) Application Interface

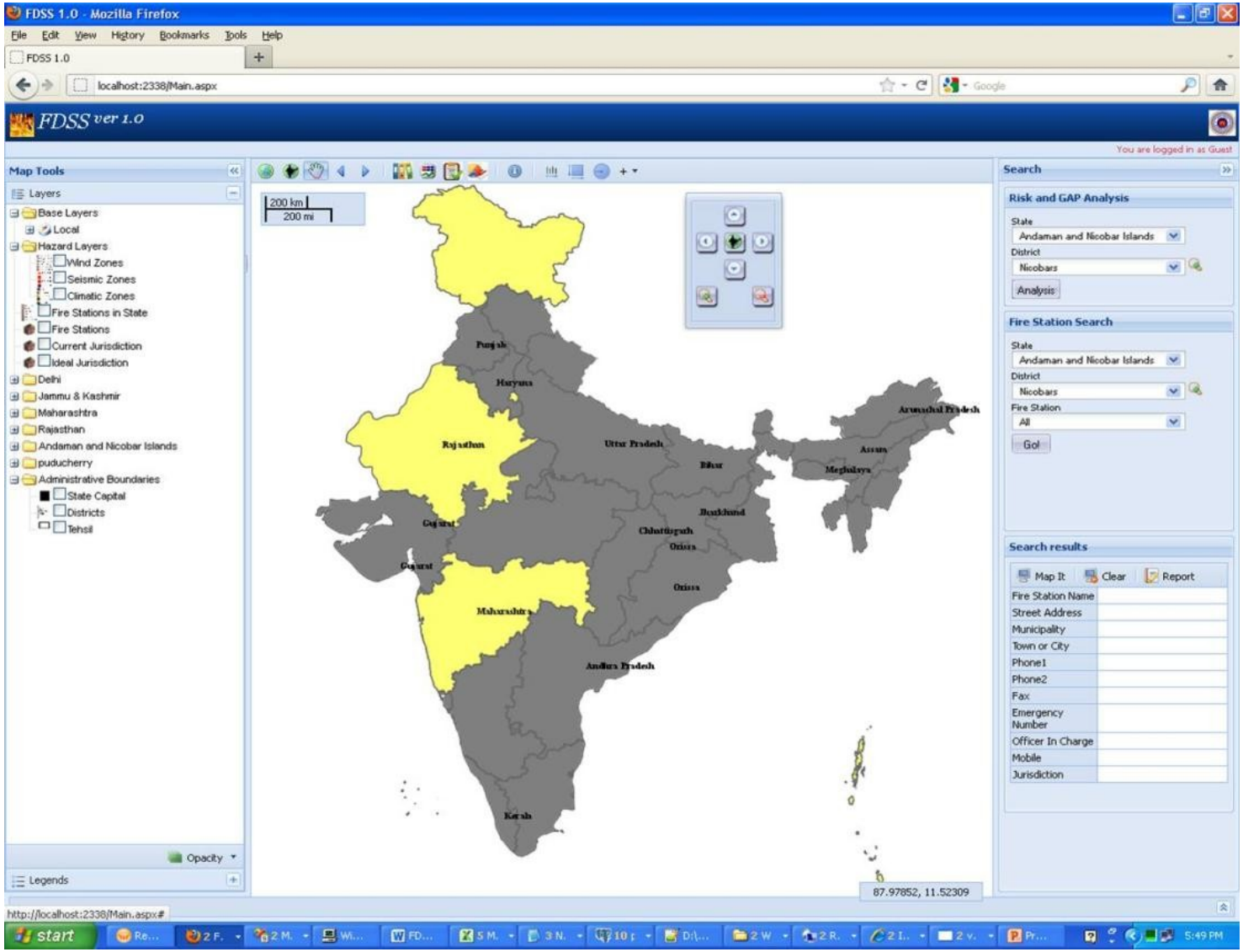


Figure 5-3 : User Interface for Base Analysis of FDSS

5.4 System Administration Interface

This is an individual stand-alone component run at the server only. This desktop interface allows the administrator to manage users and update exposure, thereby providing security for other users and preventing unauthorized updation of the building exposure data. All the data updation and maintenance is done through the system administration interface. Figure 5-4 shows the system administration interface of the application.

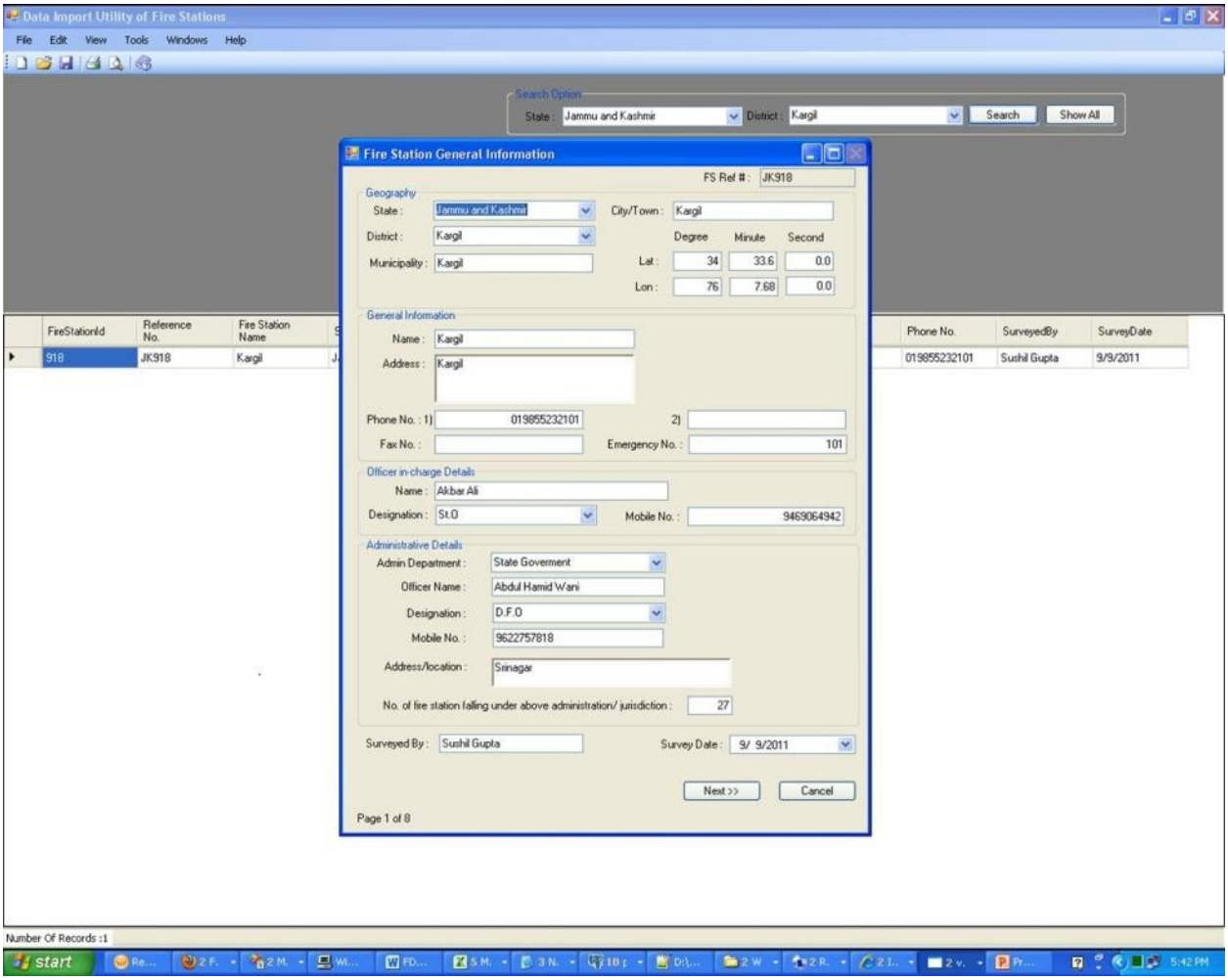


Figure 5-4 : System administration interface

5.5 Application Interface

Data Management: Exposure management provides the ability to view and query the underlying default demographic and Fire Station inventory datasets.

Map Management: The Map management interface provides support for viewing the information on a map by utilizing the Mapping Engine component from the Application Logic tier. It offers the following functionalities:

- Displays the following layers by default as the application is loaded:
  - Location of Fire Stations
  - Administrative boundary maps
  - Land use land cover map
  - Road / Rail network
  - Fire Risk Zone map

- Basic GIS tools like zoom, pan, zoom to selection, zoom to entire layer, location attribute information etc.
- Creates following maps based on analysis results:
    - Gap Analysis Map – showing gaps in existing resource, equipments and fire tenders (Figure 5-4)
- Adds custom layers to the layer manager and performs visual overlays
- Views attributes information, queries and analyzes the spatial data layers
- Enables users to view thematic maps based on defined attribute values.

Analysis Management: The analysis management interface provides the ability to execute the analysis. It allows the user the following options:

- View the fire risk analysis for any district
- Gap analysis at state and district levels

Results Management: This entails generating displays of results in pre-defined formats based on user selection. Following are the various types of result views that will be available in FDSS.

- Reports providing predefined content in predefined format. This utilizes the Reporting Engine Component to display various reports. Following is a list of various reports:
    - Fire Station Profile report
    - Gap Analysis report

5.5.1 TECHNOLOGY

The physical servers also represent the logical needs elaboration servers and the physical clients also represent the logical clients.

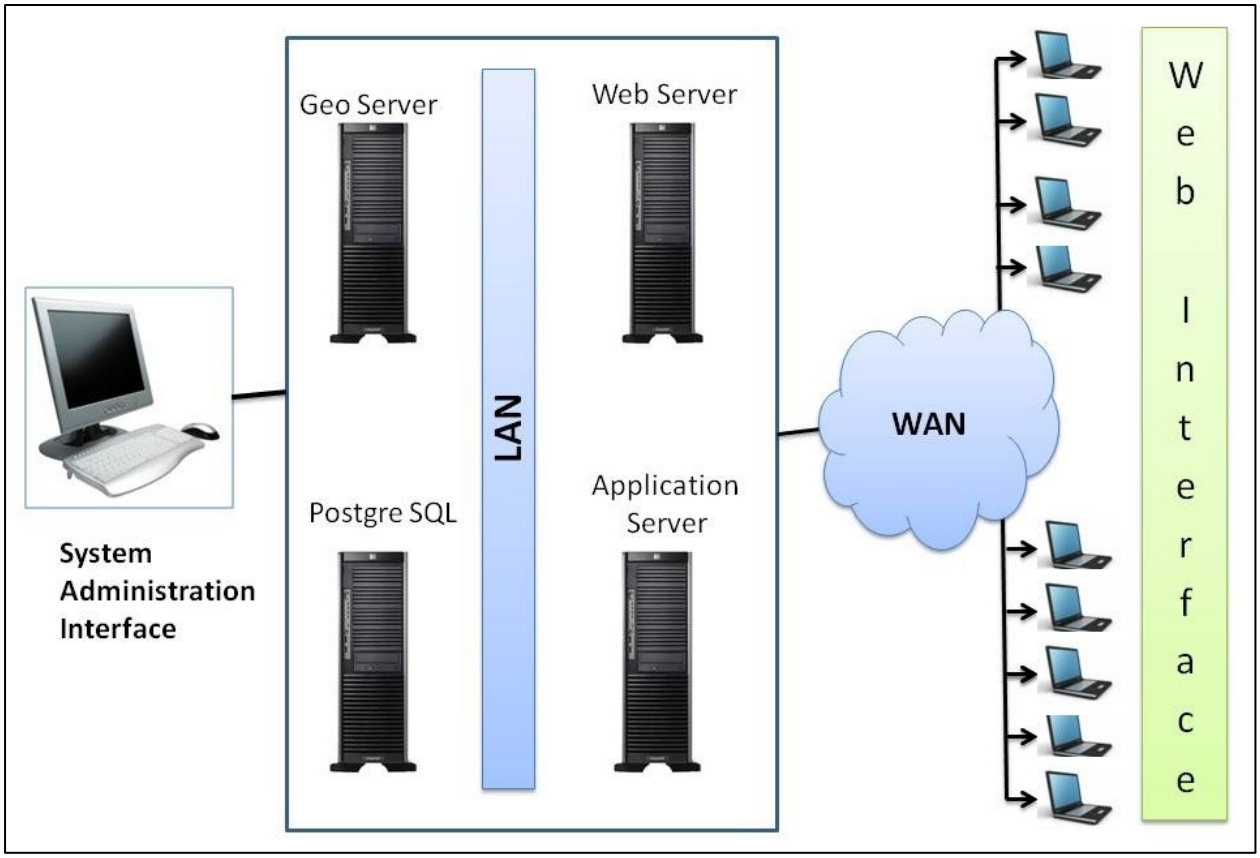


Figure 5-5 : FDSS - Systems Architecture

- The Front-end is web based, and registered users can view all kinds of maps and reports.
- Middleware: It is the Web server that hosts the web site and coordinates between the client and the backend servers for publishing maps and reports. Application Server serves as the main point of contact for the web server for all functionalities other than serving maps and GIS analyses. The application server is hosted in IIS 5.1 or higher and requires Dot net Framework 3.5.
- The backend consists of the following two components:

- Geoserver and Geo web cache: This server handles map publishing and all the GIS functionalities. For all GIS analyses it relies on the PostGIS database server. Geoserver and Geo web cache are published in Apache Tomcat Server.
- PostGreSQL Database Server: This serves all the GIS and attribute data to both the application and map servers. In addition, it also takes care of all GIS analyses required for any functionality.

The technological framework for FDSS utilizes the following platforms:

Hardware Configuration

- Rack Server 2U having Intel Xeon (Quad Core) E5410 or higher processor support for dual multi core processor
- 16 GB DDR2-533 FB DIMM or higher ECC memory
- SVGA Video Controller with 16 MB RAM
- SAS Raid Controller having 128 MB buffer memory with battery backup and supporting RAID 0,1 and 5 Dual Gigabit Server Ethernet controller with teaming, load balancing and auto fail over feature
- 5X146GB SAS HS HDDD, IDE DVD ROM Drive with (N) hot swap Redunt Hot SEAP power supply

Software Configuration

- Operating System: Windows Server 2008
- Web Server: IIS 7.0
- Framework: .net Framework (3.5)

Supported Browser

- Internet Explorer 6.0 or higher
- Mozilla Firefox 3.0 or Higher

5.6 Advantages of Open Source Platform

The application software is built on open source GIS platform. The open source GIS platform has several advantages (Table 5-1) of production and development allowing users and developers not only to see the source code of software but also modify it and easily implement it in web applications.

Table 5-1: Advantages of Open Source Platform

Advantages	Open Source Platform	Proprietary Software Platform
Control and Audit 	Gives power to control software code and hence modification can be carried out to suit the requirements	Forces users to adhere to standards and flexibility provided in the software only. Modifications are based solely on vendor discretion
Low ownership Cost 	No license fees are required thereby reducing annual license fees cost to zero, zero cost of scale as open source doesn't require additional licenses as the installation grows	License fees are required
Quality and Excellence	It's available publicly. A large no. of reviewers analyze the code making it more secure, increasing the quality and	Not available publicly.

Advantages	Open Source Platform	Proprietary Software Platform
	excellence in design	
Flexibility & customization 	There is scope to customize the software toward end users' needs	Limited scope of customization

5.7 Identification of Gaps in Infrastructure, Up-gradation and Modernization Requirement

Gap identification is carried out in FDSS using the information captured as part of the field surveys and stakeholder interviews, distribution of Fire Stations and risk analysis. The gaps in infrastructure can be in terms of number of Fire Stations in both served and un-served areas, availability of fire vehicles, fire-personnel and building infrastructure in the operational Fire Stations. Through the input of field survey work, risk categorization, and infrastructure requirement norms, gap analysis is performed in FDSS at the district and State level.

Gaps will primarily address the three areas:

5.7.1 Infrastructure gaps

This covers served/ un-served areas, unsuitable locations of Fire Stations, etc. This gap analysis is conducted by using suitably modified SFAC Norms, population density, existing Fire Station distribution and other infrastructural information obtained as part of the field surveys. In addition, the risk information has been used to reflect certain aspects of risk that affect the infrastructure. The outcomes of this analysis are information and maps that show the infrastructure deficiency at district and state levels.

5.7.2 Equipment Gaps

The objective of this analysis is to identify gaps in equipments existing at various Fire Stations against the population they serve, the hazards that the jurisdiction they serve is exposed to, trained map-power available, average response time to a fire call, etc. This will result in the identification of new types of equipments required, phasing out of old equipment and their replacement, and equipment effectiveness analysis.

5.7.3 Capacity gaps

This would cover the shortage of firefighting personnel and additional training requirements for existing teams, etc. This analysis is conducted using infrastructure analysis information, equipment analysis information, population density, SFAC norms and risk information as the primary datasets, and average response time. The primary outcomes would include the gap in capacity in terms of number of additional firefighting personnel required, and the additional requirement of trainings on equipments, tools, technologies and emergency management approaches.

Similarly, district/state/ country level reports on up gradation and modernization requirements of existing Fire Stations including MIS, GIS, and communication systems will

be generated by comparison of availability of existing resources and up gradation and modernization requirements through gap analysis.

The outcomes of the above analyses has been integrated to the Fire Decision Support System (FDSS), so similar analyses at a later stage may also be performed by changing the underlying datasets as things change on the ground.

5.8 Preparation of detail cost estimates with Capital and O&M Investment Plan

Once gaps in terms of number of Fire Stations, fire-personnel, infrastructure (building, vehicles and equipments), up gradation and modernization requirements of existing Fire Stations including MIS, GIS, and communication systems are finalized, the investment and financial analysis is performed in FDSS. This involves reviewing the outcomes of the gap analysis, prioritizing them by district and estimating the cost of investment.

The investment costs is estimated separately for infrastructure development and improvements, capacity building, and equipment procurement and modernization. This is where the extensive experience of RMSI team in fire department operations, equipment procurement, and training needs assessment and planning has been applied. For more detailed information regarding the specification of firefighting and rescue vehicles and equipment, please refer to the Vehicle and Equipment Specification report submitted by RMSI.

The outcomes of this process are a detailed investment plan that shows year-by-year investments prioritized by district, gaps and associated benefits. The financial plan addresses investment for next 10-years in a year-by-year phased manner approach. The financial tool has been integrated to the FDSS, which helps in generating various reports related to detailed cost estimates with Capital and O&M Investment Plan for next 10 years, and to prioritize investments. This is based on the current cost estimate and technological enhancement. However, the tool have flexibility to change/modify the cost of various infrastructural elements and re-regenerate reports for prioritization of the investment plan.

5.9 Institutional Assessment and Capacity Building Plan

The National Fire Service College (NFSC), Nagpur and other State Fire Training Centres across the country are key institutions involved in improving the level of fire personnel knowledge and their overall capabilities to face the challenges of fire-fighting. The RMSI team surveyed NFSC Nagpur and Pilot State/UTs Fire Training Centres across the country and studied their programs to delineate their role and relationship for improvement in training facilities for fire personnel in the country.

Human resource bottlenecks at various levels of training fire officials (such as refresher's training, breathing training in smoke, industrial training, specialized training to handle high rise fires, etc.) to different cadre of officials, issue of language in training; physical fitness; duty patterns (8 hours and 12 hours versus 24 hours); availability of accommodation in fire-stations; pay-scale structures, and promotion progression etc. are studied in detail and recommendations will be made for their implementation.

There are many ways of discovering funding avenues, such as introduction of Fire Tax, training programs to private sectors, tapping MP Local Area Development (MPLAD) funds etc. These issues are important since fire personnel need to be dedicated and motivated all times. For similar reasons, improvements in governance structure are imperative. Lack of

fire-personnel is another challenge. For this, revamping training facilities in the country is another important aspect in any Capacity Building Plan.

Computerization of fire and emergency services and strict audit by a central authority can be one mechanism to ensure a good finance mechanism for capital expenditures and operation and maintenance. Training of fire personnel in the use of computers is another aspect, which is very important from the implementation perspective.

It may be noted that RMSI team is aware of past studies on the subject such as the Recommendations by the SFAC and has kept these studies in mind while making recommendations for the Capacity Building Plan.

RMSI team has also prepared a detailed Roadmap for the Capacity Building Plan at country level for its implementation in next 10 –years. For more detailed information, please refer to the National Level Training report as well as individual State/ UT report submitted by RMSI.

6 International and National Norms

6.1 Literature Survey

Under this task, standards and practices that are being followed in various developed countries for fire safety norms, such as in USA -NFPA (1211, 1710, 1720), Japan, UK, and Germany, are being studied and compared.

As per literature survey and personnel communications with fire officials in different countries, international norms regarding response time *(defined as **en route time taken by the firefighting vehicle from the Fire Station to fire emergency scene, and turnout time is not included in it**)* differs from country to country.

6.2 Response Time

The practices regarding response time of fire tenders/ambulances in different countries are as follows:

6.2.1 GERMANY

The response from Germany (27.10.2011) is as follows:

*"1. **Concerning the response time in Berlin**. On the basis of an agreement between CFO and the Ministry of Interior the options are:*

*Calls in Risk Areas class A (higher risks) - 15 fire-fighters must arrive in **max.15 minutes** at 90% of all calls and*

Calls in Risk Areas class B (lower risks) - 15 fire-fighters must arrive in max.15 minutes at 50% of all calls.

*The standard turn out time of a fire truck is **60 seconds for professionals**, as **for volunteers** the turn out time should not be higher **4 minutes**, otherwise the Control Centre will automatically send a professional fire truck.*

*Ambulance cars must be at the scene within **8 minutes** in 75% of all calls."*

2. Temperature problem - heating devices in the garage (close the doors) and additional a electrical wire is going to the motor section of the vehicle for saving working temperature of the trucks."

From the above, it may be inferred that in Germany, areas have been divided only into two Risk Categories (higher, lower) and **response time** in urban areas varies from **8 - 15 minutes**. As far as turnout time is concerned, it varies from 1 to 4 minutes.

6.2.2 JAPAN

Fire Service laws of Japan and its background:

1. The Japanese system of laws and regulations regarding fire service law (Hierarchy structure)
   A .Law: Fire Service Act
   B. Cabinet order: Order for Enforcement of the Fire Service Act
   ・Specify the type of building fire protection
   ・Technical standards for installation and maintenance of fire prevention equipment
C Ministerial ordinance: Rule for Enforcement of the Fire Service Act
   ・Details of technical standards for installation and maintenance of fire prevention equipment"
D. Municipal ordinances: Fire prevention ordinance"

2. Requirements for Fire prevention equipments
All Fire prevention equipments are necessary to have national certification in Japan (regulation not standard).

3. Background of Japanese fire service
・Fire service in Japan consists of **one unit per municipality**.
・Under the laws, fire prevention regulations are enacted by each of the municipalities.
・Fire prevention regulations are slightly different for each individual municipality.

- **Japanese Regulation, the response time has not been determined.**

According to the Fire Service Law Enforcement Order (**not regulation**), the fire panel shall be installed where there are always people in Japan.

In large buildings, the fire panel has been installed in Guard Room. Security people are always monitoring the fire panel.
At the same time the alarm is sounded, Fire tenders will rush to the site for extinguishing the fire.
Time to reach the site, which varies depending on the building, assumed at **5 to 10 minutes. (not determined by law).**

2. Since, there are several Islands in Japan, is there any different Regulations for Islands?
Almost the same.

As you know, Japan is made up of three islands and many small islands. There has prefectures, among which are divided into municipalities regardless of islands."

From the above, it may be inferred that in Japan, each municipality has at least one Fire Station and response time varies from 5 to 10 minutes, depending upon the location of building.

6.2.3 USA

"There are three National Fire Protection Association (NFPA) standards that contain time requirements that influence the delivery of fire and emergency medical services. These are:

1. **NFPA 1221**, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems;
2. **NFPA 1710**, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments; and
3. **NFPA 1720**, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments.

NFPA 1710 contains time objectives that shall be established by career fire departments as follows:

- **Turnout time:** One minute (60 seconds) for turnout time
- **Fire response time:** Four minutes (240 seconds) or less for the arrival of the first arriving engine company at a fire suppression incident and/or eight minutes (480 seconds) or less for the deployment of a full first alarm assignment at a fire suppression incident
- **First responder or higher emergency medical response time:** Four minutes (240 seconds) or less for the arrival of a unit with first responder or higher-level capability at an emergency medical incident
- **Advanced life support response time:** Eight minutes (480 seconds) or less for the arrival of an advanced life support unit at an emergency medical incident, where the service is provided by the fire department

The standard states that the fire department shall establish a performance objective of not less than 90 percent for the achievement of each response time objective. NFPA 1710 does contain a time objective for dispatch time by requiring that "All communications facilities, equipment, staffing, and operating procedures shall comply with NFPA 1221." For the purposes of NFPA 1710, the following definitions apply:

- **Dispatch time:** The point of receipt of the emergency alarm at the public safety answering point to the point where sufficient information is known to the dispatcher and applicable units are notified of the emergency
- **Turnout time:** The time that begins when units acknowledge notification of the emergency to the beginning point of response time
- **Response time:** The time that begins when units are en route to the emergency incident and ends when units arrive at the scene

NFPA 1720 contains a time objective for dispatch time by requiring that "All communications facilities, equipment, staffing, and operating procedures shall comply with NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems." NFPA 1720 contains no time requirements for turnout and response times.

NFPA 1221 requires that 95 percent of alarms shall be answered within 15 seconds, 99 percent of alarms shall be answered in 40 seconds, and the dispatch of the emergency

response agency shall be completed within 60 seconds 95 percent of the time. The time lines for dispatching are taken from NFPA 1221:

- After the receipt of a call for assistance, the fire department will respond with the first unit to that location within three minutes.
- After receipt of a call for assistance, the fire department will respond with a unit to that location, within four minutes, to 90 percent of area served.

After receipt of a call for a medical emergency, the fire department will respond with an engine company to that location within four minutes and an ambulance within six minutes."

From the above, it may be inferred that in USA, response time varies from **(3 - 4 minutes) to 8 minutes.**

6.2.4 UK

The London Fire Brigade (LFB) is run by the London Fire and Emergency Planning Authority as part of a group of organizations operating under the 'umbrella' of the Greater London Authority. It is the third largest firefighting organization in the world, with **111 Fire Stations** (plus one River Thames-based station) from which it operates across the 1,587 sq km of Greater London, with its resident population of some 7.4 million. This increases by a further 500,000 each day during working hours.

In the year 2005/06 the London Fire Brigade answered some 268,000 emergency calls and attended nearly 156,000 incidents. On an average, the first fire engine arrived at an incident **within 8 minutes on 92 per cent of occasions**, meeting the Brigade's target, and **within 5 minutes on nearly 65 per cent of occasions**. When required, a second fire engine was on scene within ten minutes on 93 per cent of occasions, exceeding the target. (Hooper, Nov-Dec, 2006; http://www.cadcorp.com/pdf/PA-firebrigade_ukv4i5.pdf).

Another recent review of "Fire and Rescue Service response times" (Fire Research Series 1/2009) concludes that response times have increased due to traffic conditions, which was similar to the finding of the London Fire and Emergency Planning Authority thematic report, which concluded that it now ***takes 50 seconds longer for a 1st appliance to arrive on average and one minute longer for a second appliance.***

From the above, it may be inferred that in UK, response time varies from **5 to 8 minutes.**

6.2.5 INDIA

"Standing Fire and Advisory Council (SFAC) reviewed the norms in various countries, and as given in the RFP, has laid down norms for the Fire and Emergency Services throughout the country based on:-

- *Response time, fire risk, and population*
- *Depending on risk category A, B, and C the recommended response time for first fire tender is 3, 5, and 7 minutes, respectively*
- *One Fire Station per 10 sq. km in urban areas and one Fire Station per 50 sq. km in rural areas*
- *One Rescue Tender per 3 – 10 lakhs population*
- In rural areas, the recommended response time is 20 minutes

From the above, it can be inferred that SFAC norms are based on the idealized conditions of the western world and would be too demanding, thus requiring some modifications.

To see the practicability of SFAC norms, RMSI did several simulations through *network analysis* taking different average vehicle speeds for Delhi State. These different speed simulations were presented on Nov. 02, 2011 to DFS officials and on Nov 03, 2011 to Fire Advisor and Deputy Fire Advisor at DG, NDRF, MHA. After discussions with both DFS and MHA officials, the average fire vehicle speeds on main roads has been taken as 40 km/hr and minor roads as 20 km/ hr. While, for congested areas, such as Sadar Bazar, Delhi, the average fire vehicle speed on main roads has been taken as 20 km/hr and for minor roads as 10 km/hr, respectively. RMSI choose Delhi, because it has a high density of Fire Stations in comparison to the rest of the States/UTs.

Taking SFAC norms as a guideline, RMSI analyzed the requirements of Fire Stations in Delhi, keeping a response time of 3 minutes for very high-risk category, 5 minutes for high category and taking response time in rural area as 20 minutes. *It may be noted that areas served by other agencies, such as the Airport and Military Cantonment have been excluded from the gap analysis, so that there is no duplicity of Fire Stations in those areas. Additionally, areas covered by forests, rivers, sparsely inhabited (small pockets of a few houses, say in a river channel) etc. have also not been considered in the gap analysis.* To make a distinction, the Fire Stations in rural areas are designated as **Fire Stations/Fire Posts**.

Thus, taking the vehicle speeds discussed earlier, and response time as per SFAC norms, Delhi requires additional **120** Fire Stations in urban areas and **10** rural Fire Stations/posts in rural areas (Table 6-1).

Table 6-1: Number of operational and additional Fire Stations and Fire Posts required in Delhi

Urban		Rural	
Operational Fire Stations	Additional Fire Stations	Operational Fire Station/ Fire Post	Additional Fire Stations/ Fire Posts
51	**120**	**1**	**10**

As per SFAC norms, one Fire Station is required per 10 sq. km in urban areas and per 50 sq. km in rural areas. This seems to be based on average area per station over a large area/state.

From the above analysis, the average area per Fire Station in urban areas in Delhi comes to 4.7 sq km, while in rural area; it comes to 62.5 sq km. This analysis also shows that the average Fire Station coverage area in urban areas is too low when compared to the norms specified by SFAC, which is 10 sq km in urban area. Moreover, population covered in such a small area of less than 5 sq km is sometimes very low to justify opening of a new Fire Station, thus contradicting the area based norm of SFAC. Moreover, additional required number of Fire Stations will be too high and it may not be possible to set-up so many Fire Stations in Delhi, where land availability in urban areas is scarce.

Thus, keeping in view the above analyses, RMSI reanalyzed the requirements of Fire Stations in Delhi, by modifying the response time of 5 - 7 minutes for various risk categories and keeping the response time in rural area as 20 minutes. Accordingly, the proposed requirement of additional number of Fire Stations in urban and rural areas is shown in Table 6-2. In terms of average area and population served by the revised response time, the average area served comes to 8.38 sq km (close to 10 sq km) in urban areas serving an average population of 1, 61,289.

Table 6-2: Revised number of operational and additional Fire Stations and Fire Posts required in Delhi

Urban		Rural		Total
Operational Fire Stations	Additional Fire Stations	Operational Fire Station/ Fire Post	Additional Fire Stations/ Fire Posts	
51	**46**	**1**	**9**	**107**

As discussed in section 6.2.4, Greater London Authority operates 112 Fire Stations in an area of 1,587 sq km of Greater London, which is equivalent to on an average one Fire Station per 14.2 sq km. A comparison of the proposed 107 Fire Stations serving an area of 1483 sq km Delhi shows that in Delhi there will be one Fire Station on an average area of 13.9 sq km, which is almost equal to the average area per Fire Station in Greater London.

Thus, keeping in view the above analyses, RMSI recommend to modify the SFAC norms *(response time and area based)* to *response time based* norms for positioning a Fire Station, as response area will vary from place to place depending upon the road network:

Depending upon the risk category, the recommended response time for first fire tender is 5 - 7 minutes in urban areas and 20 minutes in rural areas.

Annex-1: Fire Headquarter Data Collection Form

This questionnaire is prepared in consultation with Directorate General NDRF & CD for collecting basic information all fire infrastructure in the country as part of the project "Fire-Risk and Hazard analysis in the Country" with an objective to Prepare Capital Investment and Institutional Strengthening Plan for Accelerated Development of Fire Services in the Country. All information collection through this questionnaire will be kept confidential and will only be used for the preparation of the report and other deliverables of the project. Directorate General NDRF/ CD has entrusted RMSI Private Limited to carry out this assignment and State Officials are requested to provide required authentic information which is very important for preparation of this report and future development plans of the department.

A. Fire Headquarters General Information

HQ Ref #.....

Location Details

Fire Headquarters/Zone/District Office ---------- State/UT----------

Street address …….

…….

Office Phone numbers: ……Fax…….. Web site (if any)……

Name & Designation of the Head of Department: ……..

Name & Designation of the nominated person by the dept. for providing data: ……..

Phone numbers ----------Email (s):----------

Area under Jurisdiction

Zonal Office (name and street address)	Num of districts covered	Census 2011 Population(to be filled by RMSI)	Num of Fire Stations (Operational)	Num of Fire Stations (under Construction)	Num of Fire Stations proposed for future expansion

Surveyed by: Date:

(Signature of the official provided the information)

B. Area under Jurisdiction in each Zonal Office

Name of Zonal office ……..

S.N.	Name of Fire Stations	Name of district	Under direct Jurisdiction control of[1]	Population(to be filled by RMSI)	Num of Fire Stations (Operational)	Num of Fire Stations (under Construction)	Num of Fire Stations proposed for future expansion	Any additional Information

Name of Zonal office ……..

S.N.	Name of Fire Stations	Name of district	Under direct Jurisdiction controlof[1]	Population(to be filled by RMSI)	Num of Fire Stations (Operational)	Num of Fire Stations (under Construction)	Num of Fire Stations proposed for future expansion	Any additional Information

Please add additional sheets if required

[1] State/UT Government Fire Department Police Department Municipal Corporation Others specify

C. Human Resources and Staff Welfare

Organization Structure and Human resources (Operational Staff)

By State/ zonal Level

Zone Name ……..

Level	Designation	Pay-scale	Duty Pattern	Number of sanctioned posts	Total Number of Filled posts	Total No of Vacant posts	Remark, if any
10	Director						
9	Chief Fire Officers						
8	Dy. Chief Fire Officer						
7	Divisional Officer						
6	Astt Divisional Officer						
5	Station Officer						
4	Astt Station Officer						
3	Leading Fire men						
2	Fire men/ Driver/ Fire Operator						
1	Watch Room operator						
Any other	Sweeper/ Gardener etc.						

Please additional sheets for each Fire zonal region and Fire Stations

Recruitment Rules for entry level in organization chart

Level	Essential qualifications per recruitment rule	Preferential	Training / Experience	Departmental Reservation policy if any
7				
6				
5				
4				
3				
2				
1				
Any other				

Please provide copy of state recruitment rules

Trainings Details

Training Centre Infrastructure for basic training and sub-officer course: If yes, provide details:

Name of Training Centre:

Number of Faculty/Trainers:

Name of Training Course and Duration	Maximum capacity	Number of personnel Trained annually
1.		
2.		
3.		
4.		

Training obtained by fire-staff annually (sub-officer course and above)

S. No	Type of Training Obtained	Within State/UT Training Centre	At NFSC, Nagpur	in other State Training Centre	Foreign country	Total Number of personnel Trained
1.						
2						
3						
4						

Please provide yearly break-up for the last 5 years, if available

Staff Welfare:

Please list the Staff welfare measures being followed in the state/UT:

Details can be on ration money, sports facilities, TV for common room, cash rewards and recognition, incentives, through benevolent fund, Insurance, other schemes etc.

Measures to Improve Staff Efficiency

S. no	Type of Drill	Frequency	Type of Drill (Please tick the appropriate √/ ×)					others
			Squad Drill	Pump/ Hose Drill - Dry	Pump/ Hose Drill - Wet	Ladder/ Rescue Drill	Rope Rescue Drill	
	Daily							
	Weekly							
	Bimonthly							
	Monthly							
	others							

D. Inventory of Equipments

Division Wise Fire Vehicles

Fire Station Name ----------

Division/ Station Name	Number of Deployment of firefighting units											
	water tender	Water Browser	Foam Tender	Dry Chemical Powder Tender	Emergency Tender/Rescue Tender/ Rescue Responder	Motor Pump	Motor Cycle	BA Van	Hose Tender	Aerial Ladder Platform	Hazmat Van	Others

Please provide separate list for working, non-working and under procurement

Additional Equipments

Fire Station / District/ Division Name ----------

Division/ Station Name	Gas Cutters	Bolt Cutters	Electric Drill	Circular Saw with Diamond Blade(Electric)	Chipping Hammer	Chain Saw-Diamond	Chain Saw-Bullet	Pneumatic Chisel	Spreader Cutters Hyd/electric/ Battery operated	Rescue Boats

Any other not covered in above list

…….

……..

……..

Please provide separate list for each division/district

E. Communication between HQ and Zonal/district office

Details of Control rooms

Centralized Control Room for the entire state: Yes/ No , if yes please provide location and street address:

S.No	Name of Control Room for the Division/district	Size in terms of number of Emergency Fire Telephone (EFT) lines	Command and Control		Remark
			Manual	Computerized	
1					
2					
3					
4					

State/UT Communication centre is connected with Zonal/District office through: Internet/Intranet/Wireless/Telephone lines

State/UT Communication centre is connected with individual Fire Station through: Internet/Intranet/Wireless/Telephone lines

Frequency of Fire Report Transmission:

From Individual Fire Station to District/Zonal Hq: Instantaneous, daily, weekly, bi-weekly/monthly

From Individual Fire Station to State/UT Hq: Instantaneous, daily, weekly, bi-weekly/monthly

From Individual District/Zonal Hq to District/Zone Hq: Instantaneous, daily, weekly, bi-weekly/monthly

Does State/UT have a communication policy?, *if yes, please provide a copy of the report:*

Does State/UT have any approved plans to improve communication?, if yes, please provide a copy of the plan:

F. Financial Details

Name of Zone

……

(If information provided zone wise)

Budget for year ……

Plan			Non-Plan		
Capital (Rs)	**Revenue (Rs)**		**Capital (Rs)**	**Revenue (Rs)**	
	Equipment			Equipment	
	Maintenance			Maintenance	
	POL			POL	

Please repeat if information is available for each zone/ state more than one year

G. Fire and other Incidences Summary (last 5 years)

Please provide information for each Fire Station, and District/division and Headquarter Level summary

Name of Station …….

Number of Fire and other Incidence (P= Public and FS= Fire Service)

Year	Total Calls (A+B+C+D)	Total Fire Incidence (A)	Occupancy wise break up of fire incidence				Total Rescue incidence (B)	Break up of Rescue incidence				Special service calls (C)	False/ malicious calls (D)	Totalinjured		Num of Deaths	
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			P	FS	P	FS
2010-11																	
2009-10																	
2008-09																	
2007-06																	
2006-07																	

Severity of fire incidences at each Fire Station, and District/division and Headquarter Level summary

Year	Total no of Small Fire Incidence	Total no of Medium Fire Incidence	Total no of Serious Fire Incidence	Brief description of Major Fire Incidence
2010-11				
2009-10				
2008-09				
2007-06				
2006-07				

(Attach additional sheets for each region/ and addition year)

Please provide definition of fire types

……

……

Severity of events: Small fire – estimated loss of Rs. 10 lakhs, Medium – Rs. 10 to 50 lakhs, Serious - >Rs. 50 lakhs, any fire where there is human death to be consider as Serious fire. (As per the compendium, even there is causalities, it is considered as serious, but the causality severity not mentioned *……..*

H. Public Awareness Programs

Public Awareness Programs organized in last One Year

Name of Zonal/district Office ……

Total no. of programs in the year including Fire Safety Week (a +b + c)	Total no. of persons attended (d + e + f)	No of Programs Organized			No of Persons attended			Brief description of the programs
		Govt./ PSU (a)	Pvt. Locations (b)	Schools (c)	Govt./ PSU (d)	Pvt. Locations (e)	Schools (f)	

I. Suggestions/views of the department for improvement of fire and emergency service in the state

1.
2.
3.
4.
5.
6.
7.
8.
……

Contact person Details for Communication at RMSI (On behalf of DGCD, Fire Project Cell):

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<sushilgupta74@yahoo.com>
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Annex-2: Fire Station Survey Form

This questionnaire is prepared in consultation with Directorate General NDRF & CD for collecting basic information all fire infrastructure in the country as part of the project "Fire-Risk and Hazard analysis in the Country" with an objective to Prepare Capital Investment and Institutional Strengthening Plan for Accelerated Development of Fire and Emergency Services in the Country. All information collection through this questionnaire will be kept confidential and will only be used for the preparation of the report and other deliverables of the project. Directorate General NDRF has entrusted RMSI Private Limited to carry out this assignment and State Officials and Official in-charge of Fire Station are requested to provide required authentic information which is very important for preparation of this report and future development plans of the department.

SW FS Ref #.....

A. Fire Station General Information

State	District	City/ Town	Block / Tehsil	Municipality	Latitude , Longitude (to be filled by RMSI)(DDM format)		ID

Fire Station Name .....

Address of the Fire Station (with landmark) .....

.....

Station Phone number(s) with STD code: 1) ..... 2)..... 3).....

Fax No: .....

Emergency No: .....

Fire Station Type based on served area: Urban ☐ *Rural* ☐

Name of officer in-charge ..... Designation .....

Mobile number *(officer in-charge)* : .....

Fire Station is under the administration of (put tick mark in the box)

State Government ☐ Municipal Corporation ☐ Police Department ☐ Others specify.....

The Fire Station falls under the jurisdiction of (Division/Zone/Municipality) -.....

Name of Administrative District/Divisional/Zonal Fire Officer- .....Mobile.....

Address/location of District/Divisional/Zonal HQ- .....

Number of total Fire Stations fall under above jurisdiction/ administration- .....

Surveyed by: **Date:**

(Signature of Witness from Fire Department)
Name & Designation

B. Fire Station Infrastructure Details

Does Fire Station has its own building: Yes in good condition, Yes, but condition is not good & need new building.

No permanent building

If Fire Station is temporarily operational from borrowed/ rented building of ……(Private, Municipality, Police, any other ……)

Please mentioned the status : Land acquired -…Yes/ No… and building under construction -……Yes/ No….

How many bay station should be in new Fire Station building

If permanent building - Fire Station belongs to State Fire Department / State Government / Municipal Corporation / Police fire Service/ any other

Provide building details

Number of Floors	Number of Rooms	Approx Plot Area (SQM)	Approx Built-up Area (SQM)

Whole Fire Station Building Structure Type : Pacca - Reinforced concrete (RCC) frame structure Pacca -Masonry with RCC Roof Pacca Masonry walls with flexible Roof Kachha masonry walls with Tin Roof Kaccha Tin shade Temp Porta- cabins Kaccha wooden structure with tin Roof Others kaccha type specify ……

Mixed (kachha and pacca) (in case different parts of Fire Stations has different structure types)

If whole station building is not a permanent (Pacca) building structure and need new partial building, please specify the details of partial components that needs to be build

Vehicle bays (with num of bays) Fire Station office building Barracks Staff quarters

Age of building structure/ year of construction- …….. (write year in the blank space and tick in the box below)

Less than 5yrs 5-10 yrs 10-20yrs More than 20 yrs

Number of Bays/Garages for the Fire Vehicles - , How many fire vehicle parked within Bay/ Garage

Structure of Bay/ Garrage- Pacca- RCC/Masonry Kaccha Tin Shade Open any other Kaccha ……..

Availability of Staff Quarters - Yes No , If Yes, mention numbers……

Availability of Barracks - Yes No , If Yes, mention numbers and total capacity……

Availability of T.V. in Barracks - Yes ☐ No ☐ Any other entertainment indoor/ outdoor……

Provision of Mess/ Canteen facilities in Fire Station- Yes ☐ No ☐

Availability of Watch room /Control Room- Yes ☐ No ☐ If yes, is it computerized - Yes ☐ No ☐

Is Watch room /Control room online/ internet connected with zonal/ headquarter Yes ☐ No ☐

Availability of drill/ parade ground - Yes ☐ No ☐ Availability of hose drying/ drill tower - Yes ☐ No ☐

Power Supply in the Fire Station Watch Room/ Control Room -

Electricity: Uninterrupted 24 Hrs ☐ Interrupted supply ☐ Availability of standby generator ☐ Inverter for control room ☐

Does the Fire Station maintain ambulance unit ? Yes ☐ No ☐

C. Communication Systems

1. Between Public and Fire control room/ watch room
   i. Landline Telephone: Yes ☐ No ☐ , If 'Yes', mention number of landline phone in operation……
   ii. Emergency phone number- 101 or,……..Connection Type : Direct ☐ Indirect ☐ Not Available ☐
2. Hotline between Important agencies and Fire control room
   Oil industries/ storage ☐ Airport ☐ PCR ☐ Banks ☐ District Magistrate Office ☐
   Others specify……
3. Automatic Fire Alarm between High Rise Buildings and Fire Station: Yes ☐ No ☐ If yes, num. of buildings …….
   If with any other agency, specify: ……

Availability of GPS on Fire Engines and other vehicles - Yes ☐ No ☐ , If Yes, mention number of vehicles: ……..

4. Between Fire Station Control Room and Fire Vehicles
   Static Wireless Set in watch room Yes ☐ No ☐ If 'Yes', mention number of operational phones ……
   Number of Mobile wireless sets: ☐ Number of Walky-Talky: ☐ Number of Satellite Phones: ☐
5. Type of Frequency used- HF ☐ VHF ☐ UHF ☐

D. Water Supply Details for Fire Fighting Purpose

Whether 24 hours water available in fire vehicles? Yes ☐ No ☐

Water sources used by Fire Vehicles within Fire Station

Direct supply… ☐ … b) Overhead tank ☐ c) Pumping from underground tank … ☐

d) Pumping by Tube well ☐ .. e) any other ……

Any storage of water within Fire Station for fire vehicles- Yes ☐ No ☐

Water sources regularly used by Fire Vehicles outside Fire Station (also mention distance in km from Fire Station)

City over-head tank with coupling arrangements ☐ River ☐ Stream ☐ Well ☐ Pond ☐ Lake ☐

Other location / static fire hydrant available in the vicinity - Yes ☐ No ☐ ,If 'Yes', provide number and distance (km) ……,……..……

Overall, is there any scarcity of water for fire vehicles- Yes ☐ No ☐

E. Human Resources

Permanent Staff Details- :

S. no.	Designation	Total Number of Permanent Working Staff	Duty pattern/ Shifts (hrs)	Vacant, but sanctioned posts	Numbers of temporary/ contract persons (if any)
1.	Senior Fire Officers		24 hrs		
2.	Station Officer (St.O)/(FSO)				
3.	Sub Officer (S.O)/FSSO				
4.	Leading Fire Men (LFM)				
5.	Driver				

S. no.	Designation	Total Number of Permanent Working Staff	Duty pattern/ Shifts (hrs)	Vacant, but sanctioned posts	Numbers of temporary/ contract persons (if any)
6.	Fire Man (FM)				
7.	Sweeper				
8.	Cook				
9.	Any other				
10.	Any other				

Total Permanent Staff in the Fire Station [ ] Details of Temporary staff/ Contract persons (if any)……

***Level 10**: Director General/ Director; **Level 9**: CFO/ CO; **Level 8**: Deputy CFO/Joint Director; **Level 7**: AD/Deputy Controller/Deputy Director/DO; **Level 6**: ADO/ Inspector/EO/Fire Supervisor; **Level 5**: DFO/ADFO/AFO/Fire In-charge; **Level 4**: St.O/Sub Inspector/Station In-charge/ASt O./AEO; **Level 3**: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/; **Level 2** : LFM/ Mechanic Driver/Head Constable/Store Superintendant; **Level 1** : FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk; **Level 0:** Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Cleaner, Tindal.*

Mode to maintain Physical Fitness

S. no	Type of Drill	Yes/No	S. no	Type of Drill	Yes/No
1.	P.T./ Parade	Daily/……	4.	Vehicle maintenance	Weekly/Monthly/Quarterly/……
2.	Fire Drill	Daily/Weekly……	5.	Any other	……
3.	Games	Daily/ ……			

F. Fire Risk Covered in the Area under Jurisdiction

Jurisdiction of Fire Station (in approx sq km) ……*(collect current* jurisdiction *map from the Fire Station)*

Fire Risk	If Yes, Brief description of its Name, Type, Risks involved	Dist. From FS (km)	No. of Units
Old city Area/ congested areas			
Jhuggi -Jhopdi (Thatched House Clusters)			
Industrial Area (also mention whether small/medium/large scale)			
Industrial Area (any other)			
High-Rise Buildings (>15m height)			
Major Scrap yards (Iron/Wood etc)			
Oil Mills/Storage/Processing Units			

Fire Risk	If Yes, Brief description of its Name, Type, Risks involved	Dist. From FS (km)	No. of Units
Refineries			
Underground Gas pipe lines			
LPG Bottling Plant			
Water –Treatment Plant (chlorine cylinders)			
Bulk Fuel Storage Area/ Petrol Pump			
Major Hazardous (MAH) units			
Explosive manufacturing/stores			
Port/ dockyard area			
Railway Station			
Airport Area			
Wild Forest-Area			
Vicinity to Coast			
Army Ammunition Storage			
Cross-Border Shelling			
Any other			
Any other			

Availability of water for Fire Fighting in High-Rise Building as per National Building Code (NBC) - All ☐ Few ☐ No ☐

Applicability of NBC/ local laws in District/ State for fire safety of High-Rise building - All ☐ Few ☐ No ☐

Applicability of NBC/ local laws for fire safety in industrial and other buildings- All ☐ Few ☐ No ☐

G. Status of Fire Fighting Vehicles (attach separate sheet if number of vehicle are more than space provided below)

(Total number of Fire Fighting Vehicles at station ……..…)

Sl No	Fire Vehicle Type	Fire Dept. Vehicle Number	Vehicle Registration Number	Make	Year of Fabrication (age)	Size/ water capacity (ltr)	Pumping capacity/ size (LPM)	Comm. System mounted on vehicle	If not in running condition (off road)
	Water Tender (WT) 1							Wireless / GPS	Minor/ Major/Condemned
	Water Tender (WT) 2							Wireless / GPS	Minor/ Major/Condemned
	Water Tender (WT) 3							Wireless / GPS	Minor/ Major/Condemned
	Water Bowser (WB) 1							Wireless / GPS	Minor/ Major/Condemned
	Water Bowser (WB) 2							Wireless / GPS	Minor/ Major/Condemned
	Foam Tender (FT)							Wireless / GPS	Minor/ Major/Condemned
	DCP Tender					kg		Wireless / GPS	Minor/ Major/Condemned
	Multi-purpose Tender							Wireless / GPS	Minor/ Major/Condemned

Sl No	Fire Vehicle Type	Fire Dept. Vehicle Number	Vehicle Registration Number	Make	Year of Fabrication (age)	Size/ water capacity (ltr)	Pumping capacity/ size (LPM)	Comm. System mounted on vehicle	If not in running condition (off road)
	Hose Tender (HT)							Wireless / GPS	Minor/ Major/Condemned
	Rescue / emergency tender/ responder							Wireless / GPS	Minor/ Major/Condemned
	Advanced Rescue Tender (with inst. to handle hazardous materials)							Wireless / GPS	Minor/ Major/Condemned
	Aerial Ladder Platform (ALP)							Wireless / GPS	Minor/ Major/Condemned
	Turn Table Ladder (TTL)							Wireless / GPS	Minor/ Major/Condemned
	Hazmat Van							Wireless / GPS	Minor/ Major/Condemned
	B.A. Van							Wireless / GPS	Minor/ Major/Condemned
	Quick Response Tender (QRT)							Wireless / GPS	Minor/ Major/Condemned
	Motor Cycle Mist 1							Wireless / GPS	Minor/ Major/Condemned
	Motor Cycle Mist 2							Wireless / GPS	Minor/ Major/Condemned
	Rescue Boat							Wireless / GPS	Minor/ Major/Condemned
	Fire Boat							Wireless / GPS	Minor/ Major/Condemned
	High Pressure Light Van							Wireless / GPS	Minor/ Major/Condemned
	Any Other							Wireless / GPS	Minor/ Major/Condemned

Details of Vehicles- other than Fire Fighting/ Official Use

Sr No	Fire Vehicle Type	Vehicle Registration Number	Make	If allotted to individual	Comm. System mounted on vehicle	If not in running condition (off road)
	Ambulance				Wireless / GPS	Minor/ Major/Condemned
	Motor cycle (office use)				Wireless / GPS	Minor/ Major/Condemned
	Motor cycle (office use)				Wireless / GPS	Minor/ Major/Condemned
	Jeep/ Gypsy (office use)				Wireless / GPS	Minor/ Major/Condemned
	Jeep/ Gypsy (office use)				Wireless / GPS	Minor/ Major/Condemned
	Bus/ Mini Bus				Wireless / GPS	Minor/ Major/Condemned
	Other Transport Vehicle				Wireless / GPS	Minor/ Major/Condemned
	Any other				Wireless / GPS	Minor/ Major/Condemned

H. Specialized Equipment provided (mention total quantity for all equipment including vehicle and storage)

Equipment	Number/ Quantity	Equipment	Number/ Quantity
Self rescue units ropes/slugs (ft)		Ladders (extension + hook)	
Foam compound (ltr.)		Hand controlled nozzle/ branches	
Foam making branches (tool)		Fog/ Mist Branch	
Breathing Apparatus (B.A.) Sets		B.A. Compressor	
Personal Protection Suits (multi-layer suits etc)		Combi Tool	
Personal Protection Equipment (PPE) (protection suit with BA sets etc)		Jumping cushion / sheets	
Chemical Suit		Dry Chemical Powder (DCP) Extinguisher	
Lock cutter		First-Aid Box	
Hydraulic Rescue Tool (spreader, cutter, rams)		Portable Pump	
Electric powered hammer/ floor breaker		Submersible Pumps	
Electric chain saw for wood		Pneumatic Lifting Bag (capacity -Ton)	

Equipment	Number/ Quantity	Equipment	Number/ Quantity
Electric powered concrete cutter saw		Thermal Imaging Camera	
Electric chain saw for concrete		Life Locator Equipment	
Petrol Powered Concrete Cutter Saw		Chemical Leakage/Gas Detection Kit	
Petrol Chain Saw for Concrete		Radio-active Leakage Detection Kit	
Petrol Chain Saw for Wood		Curtain Spray Nozzle	
Hydraulic Chain Saw for Wood		Escape Chutes (length m)	
Long Branch		Search Light	
Short Branch		Generator Set	
Diffuser		Robots if any	
Lifebuoy		Fire-Curtain	
Life Jacket		Floating Pump	
Diving Suit (Wet / Dry)		Smoke Exhauster/ PPV	
Fire Beater		Any Other…	
Inflatable Lighting Tower		Any Other…	

I. Other Dress Accessories

Normal Dangri	Individual issue / Group use	
Helmets (steel/leather/fiber)	Individual issue / Group use	
Gum Boots	Individual issue / Group use	
Fire retardant Dangri	Individual issue / Group use	
Any Other		

Any other incentives for staff such as ration money, insurance etc

Ration money – Yes ☐ No ☐ Amount (Rs) ……..

Insurance - Yes ☐ No ☐ Amount (Rs) ……..

J. Suggestions/views of fire-official for improvement of fire and emergency service at the station

1)……
……

2)……..……
……

3)……
……

K. Other Fire Station (nearby) not belonging to Fire Service Department

Airport / Defence Installations / Power Plant (all type) / Oil Refineries / Private Agency / Other Industries etc.

a) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……..

b) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……..

c) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……

L. Fire Calls and other Incidence Statistics (last 3-5 years) Name of Fire Station ……..

Monthly number of fire calls and other special service calls (use additional sheet to pen down the Fire Statistics for last 5 years)

Month-Year	Total Calls (A+B+C+D)	Total Fire Incidence calls (A)	Occupancy wise break up of fire incidence (if any)				Total Rescue incidence (B)	Break up of Rescue incidence (if any)				Special service calls (C)	False/ malicious calls (D)	Total injured		Total Death
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			Minor	Major	
12-Jul																
12-Jun																
12-May																
12-Apr																
12-Mar																
12-Feb																
12-Jan																
11-Dec																
11-Nov																
11-Oct																
11-Sep																
11-Aug																
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9-May																
9-Apr																
9-Mar																
9-Feb																

9-Jan																
8-Dec																
8-Nov																
8-Oct																
8-Sep																
8-Aug																

Please send Fire call statistics to :

Mr. Sushil Gupta (General Manager), Risk Modeling & Insurance,
A-7, RMSI, Sector 16, Noida 201301, Fax: 0120 2511109
Mobile: 08826100332, phone: 0120 4040512(direct)
Sushil.Gupta@rmsi.com

PART – B

7 Delhi State

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8 Rajasthan State

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9 Maharashtra State

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10 Jammu and Kashmir State

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11 Puducherry UT

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Andaman & Nicobar Islands

12 Andaman and Nicobar Islands

12.1 Introduction

The Andaman & Nicobar are a group of picturesque Islands, big and small, inhabited and uninhabited, a total of 572 islands, islets and rocks lying in the southeastern part of the Bay of Bengal. They lie along an arc in long and narrow broken chain, approximately North-South over a distance nearly 800 km. The groups of islands are located between latitude 6 ° - 14° N and longitude 92 ° - 94° E (Figure 12-1). Saddle peak located in North Andaman Island is the highest point of the state with an elevation of 732 m. Port Blair is the capital of Andaman and Nicobar Island located in South Andaman district.

The Andamans are separated from the Nicobar group by a channel (the Ten Degree Channel) some 150 km wide. The Andaman group has 325 islands, which cover an area of 6,408 km^2, while the Nicobar group has only 24 islands with an area of 1,841 km^2. The northernmost point of the Andaman and Nicobars group is 901 km away from the mouth of the Hooghly River and 190 km from Burma. The southernmost island, Great Nicobar's southernmost point, called *Indira Point*, lies only 150 km from Sumatra, Indonesia. The capital of the union territory, Port Blair, is located 1,255 km from Kolkata, 1,200 km from Visakhapatnam and 1,190 km from Chennai.

In Andaman and Nicobar Islands, rural population is 64.33% of the total population with the urban population consisting 35.67% (Table 12-1). In case of Nicobars district, entire population resides in rural areas.

Table 12-1: Details of Andaman and Nicobar Islands UT demographic profile (Census 2011)

Andaman and Nicobar Islands UT			
As per Census 2011			
No. of Districts	3		Decadal growth of Population
No. of Sub-districts	9		
No. of Census Towns	4		6.68%
No of Villages	555		
Population			
	Total	Rural	Urban
Persons	379,944	244,411	135,533
Male	202,330		
Female	177,614		
Sex Ratio (females per 1,000 males)	878		

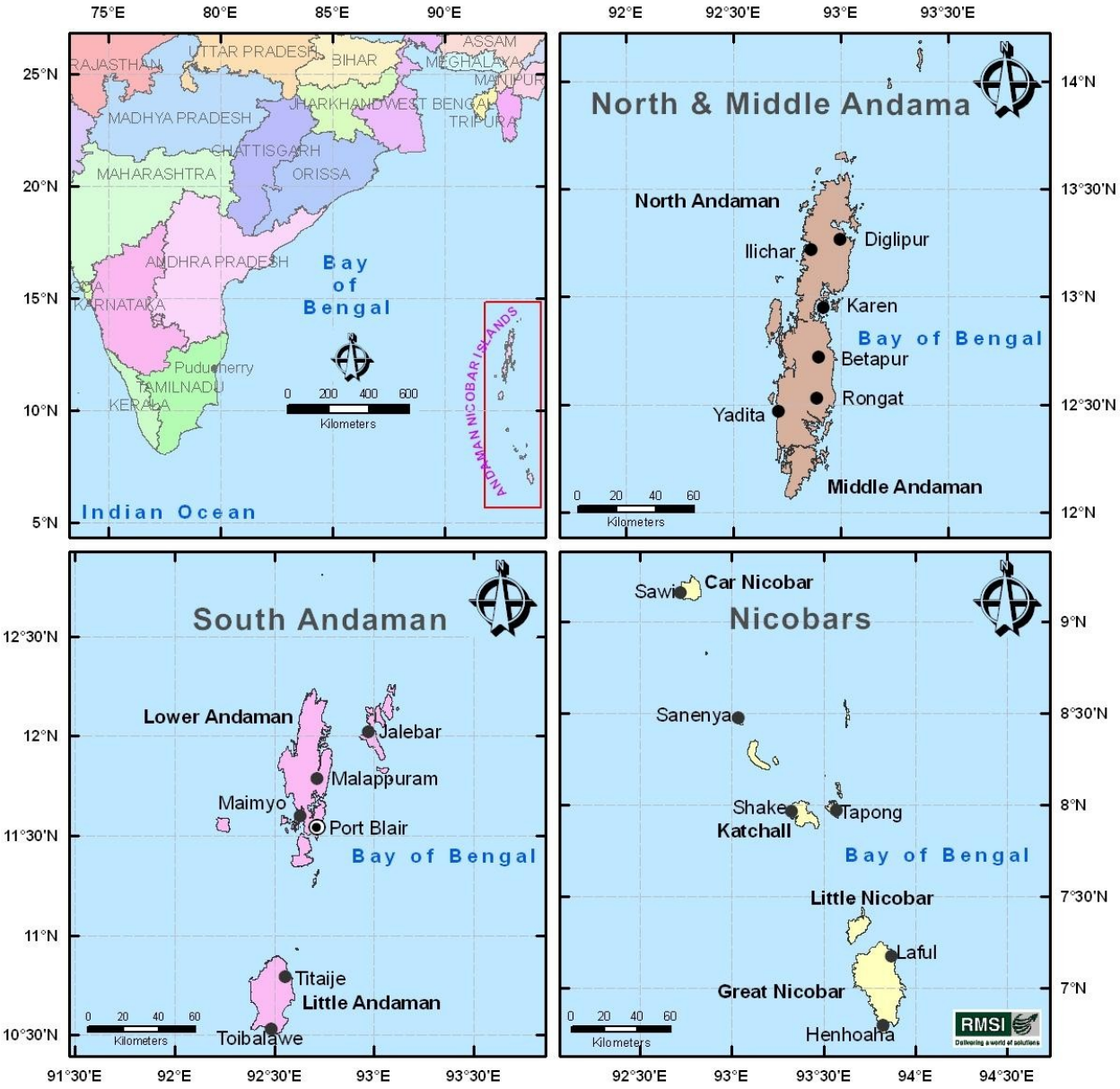

Figure 12-1: Location map of Andaman and Nicobar Islands

As per the "Vulnerability Atlas of India" (BMTPC, 2006), the whole Andaman and Nicobar Islands lie in the Very High Damage Seismic Risk Zone. In terms of wind damage, the Union Territory of Andaman and Nicobar Island falls in Moderate damage Risk Zone - A (Vb=44m/s).

The Fire Service in Andaman and Nicobar Islands is under Department of Police, functioning as a separate unit technically headed by the Chief Fire Officer (CFO) under the control and supervision of Dy. Inspector General Police, Andaman & Nicobar Islands and the head of the department is Director General of Police, A&N Islands. The Andaman & Nicobar Fire Service has presently 20 Fire Stations (4 in Nicobars district, 5 in North & Middle Andaman district and 11 in South Andaman district); Fire Service provides fire coverage to all-important habited Islands of this territory (Tables 12-2 and 12-3; Figures 12-2 to 12-4).

Andaman and Nicobar Police Fire Service Department also have a Fire Service Training Centre at its Headquarter (Aberdeen Fire Station, Port Blair) and imparts basic training to fire personnel.

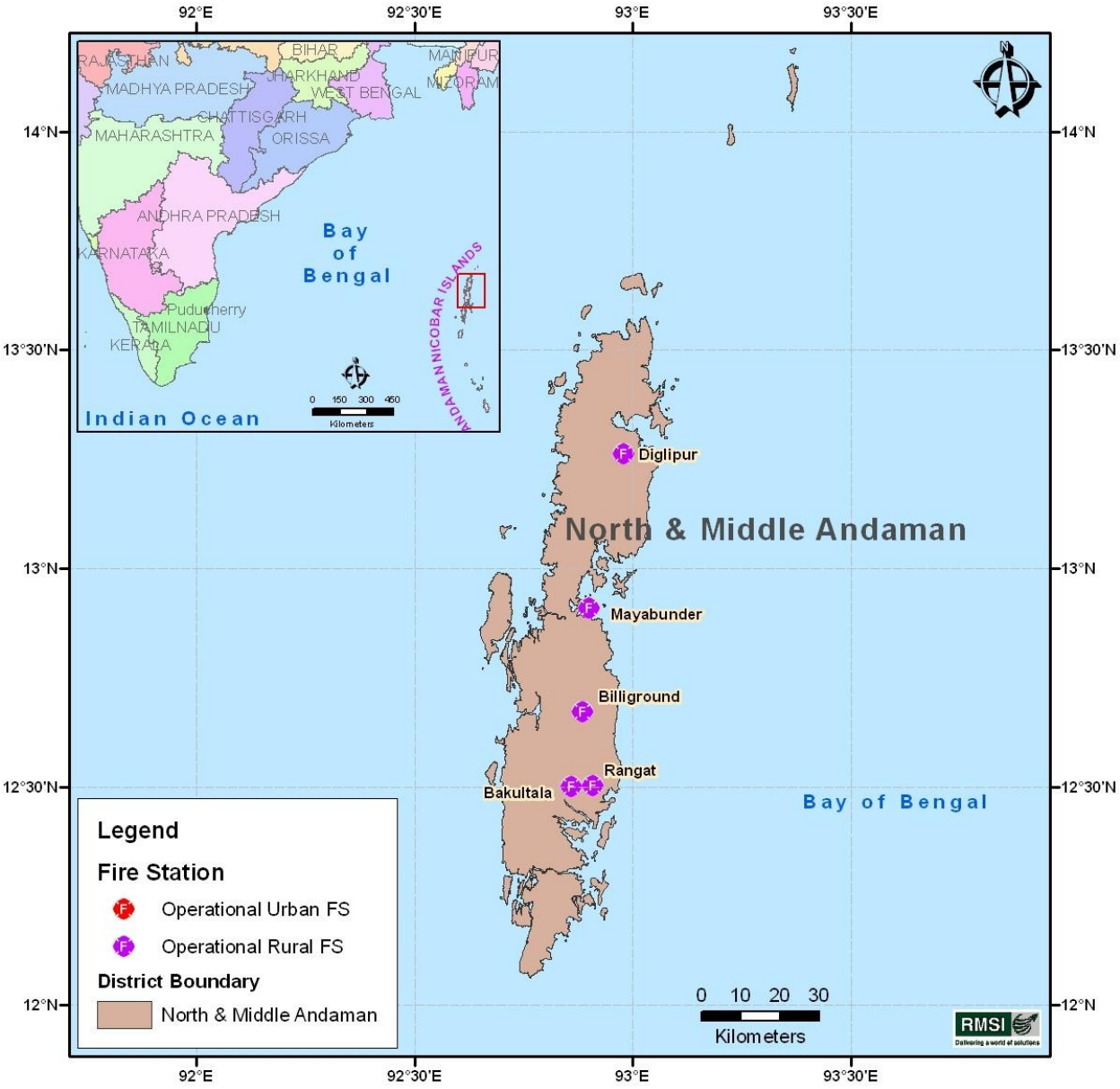

Figure 12-2: Location of operational Fire Stations in North and Middle Andaman district

Table 12-2: District name, population distribution and number of Fire Stations in each district

District	Population (2011)	Male (2011)	Female (2011)	Number of Fire Stations
North & Middle Andaman	105,539	54,821	50,718	5
South Andaman	237,586	126,804	110,782	11
Nicobars	36,819	20,705	16,114	4
Total	379,944	202,330	177,614	20

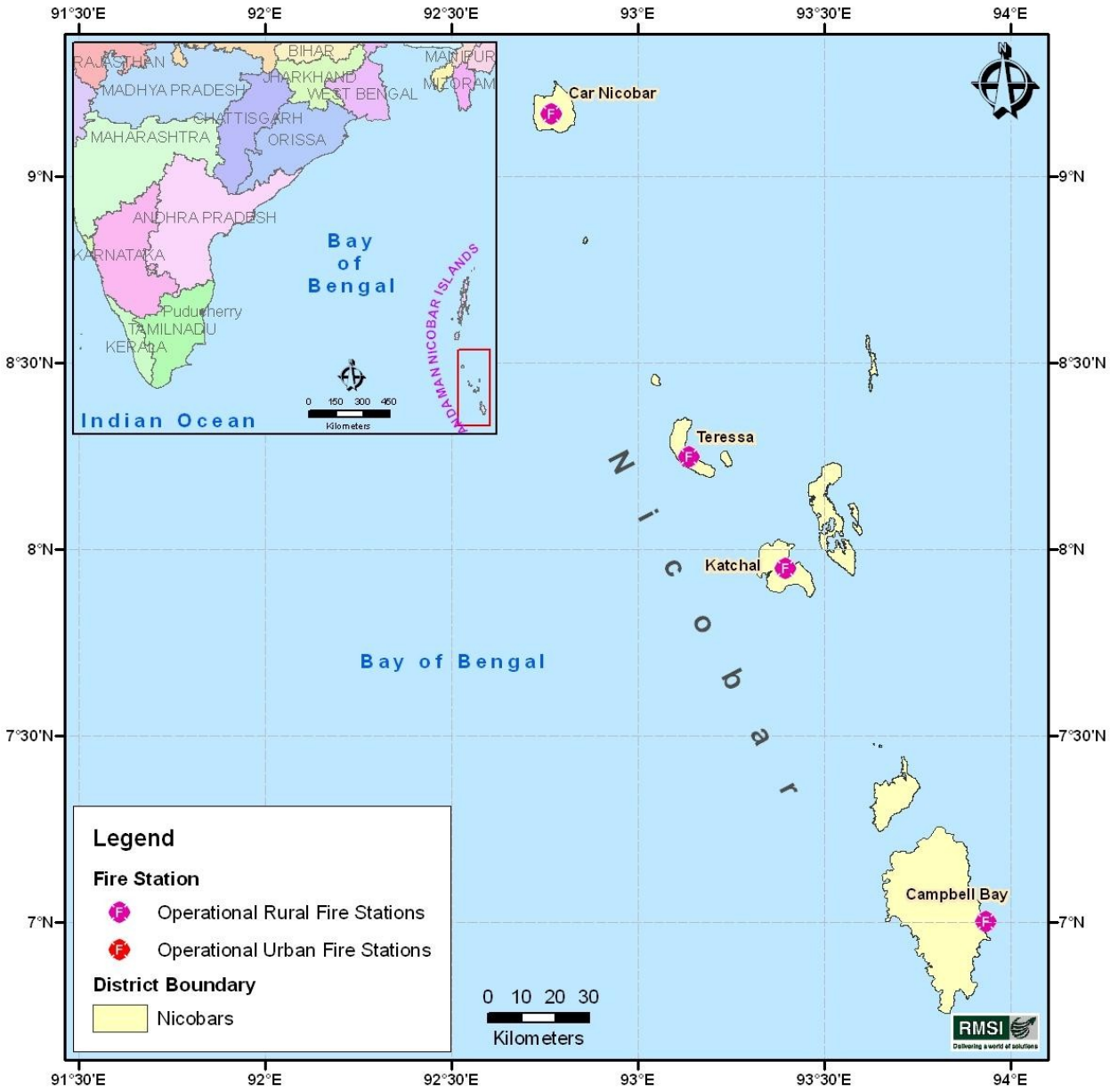

Figure 12-3: Location of operational Fire Stations in Nicobar district

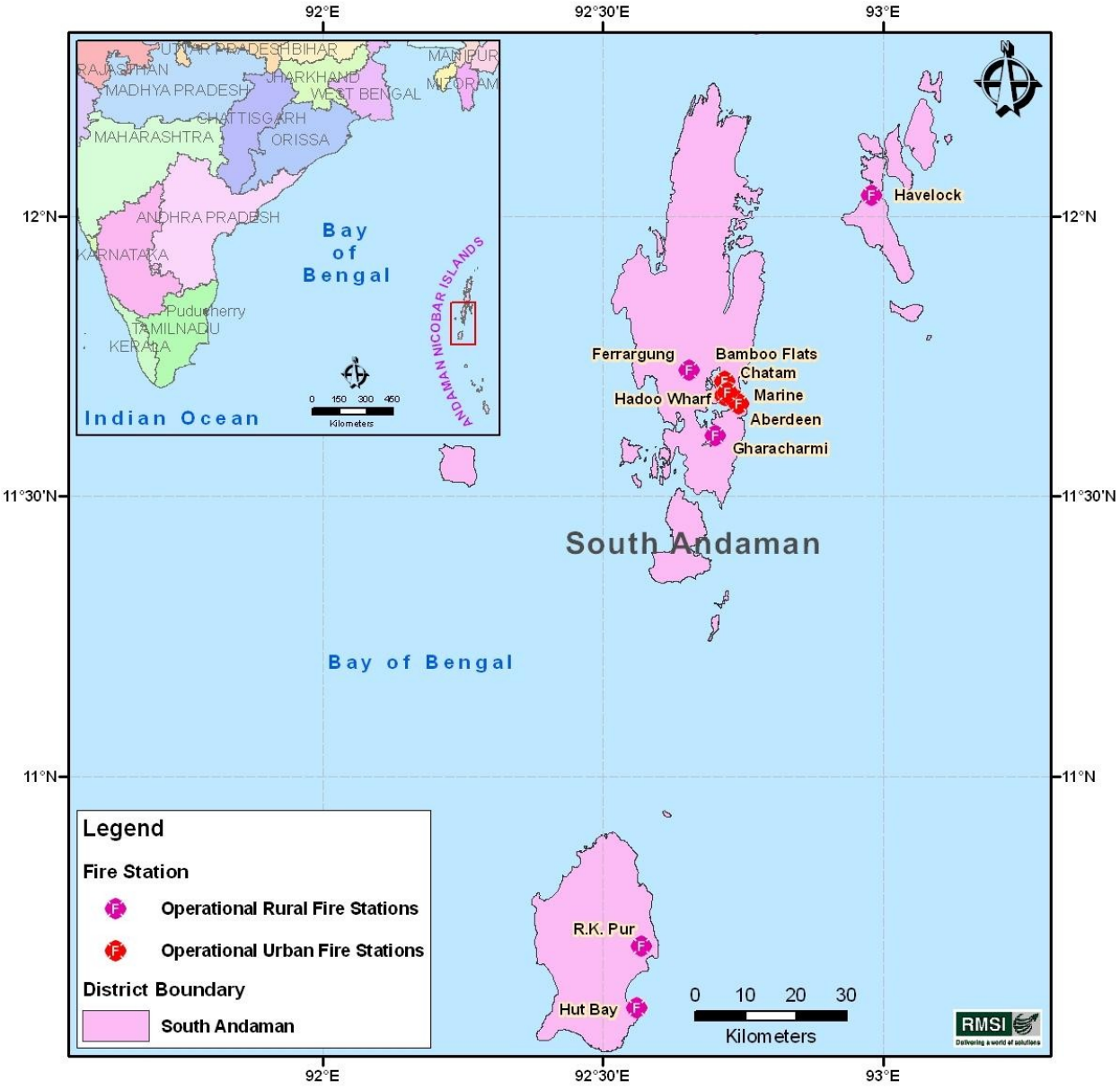

Figure 12-4: Location of operational Fire Station locations in South Andaman district

Table 12-3: Details of operational Fire Stations of Andaman & Nicobar Police Fire Service

Sl No	Census District Code	District	Town/ City	Fire Station Name
1	3501	South Andaman	Port Blair	Aberdeen Fire Station
2	3501	South Andaman	Bamboo Flats	Bamboo Flats Fire Station
3	3501	South Andaman	Port Blair	Chatam Fire Station
4	3501	South Andaman	Ferrargung	Ferrargung Fire Station
5	3502	South Andaman	Port Blair	Gharacharmi Fire Station
6	3502	South Andaman	Port Blair	Hadoo Wharf Fire Station
7	3502	South Andaman	Havelock	Havelock Fire Station
8	3502	South Andaman	Hut Bay	Hut Bay Fire Station
9	3502	South Andaman	Kadamtala	Kadamtala Fire Station
10	3503	South Andaman	Port Blair	Marine Fire Station
11	3503	South Andaman	R.K. Pur	R.K. Pur Fire Station
12	3503	North & Middle Andaman	Rangat	Bakultala Fire Station
13	3503	North & Middle Andaman	Billiground	Billiground Fire Station
14	3503	North & Middle Andaman	Diglipur	Diglipur Fire Station
15	3503	North & Middle Andaman	Mayabunder	Mayabunder Fire Station
16	3503	North & Middle Andaman	Rangat	Rangat Fire Station
17	3503	Nicobars	Campbell Bay	Campbell Bay Fire Station
18	3503	Nicobars	HQ Car Nicobar	Car Nicobar Fire Station
19	3503	Nicobars	Katchal	Katchal Fire Station
20	3503	Nicobars	Teressa	Teressa Fire Station

On an average, each operational Fire Station of Andaman & Nicobar Police Fire Service Department is serving a population of about 19,000 persons.

12.2 LULC Map of Andaman and Nicobar Islands UT

Figure 12-5 and figure 12-6 shows the LULC map of Andaman and Nicobar Island Union Territory. From the map, residential built-up areas can be seen quite clearly apart from other land use classes.

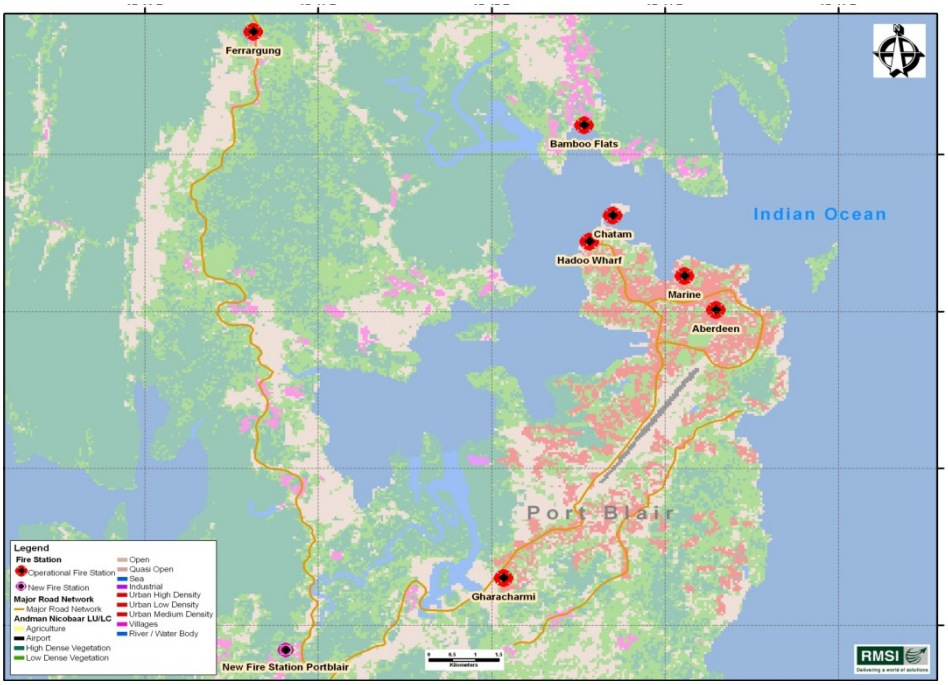

Figure 12-5: LULC map for Port Blair, South Andaman district

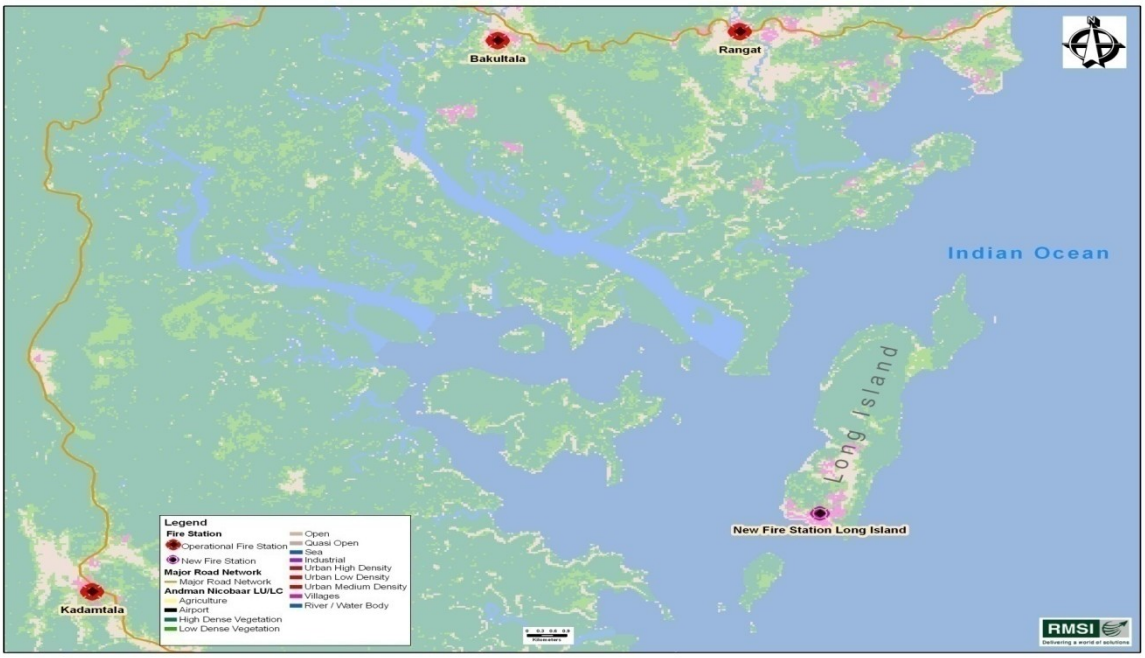

Figure 12-6: LULC map for Long Island, North and Middle Andaman district

12.3 Field Surveys of Fire Stations for Data Collection

To have first-hand information on the distribution of the fire service stations across the country, trained human resources, infrastructure availability and their status, RMSI project team has carried out detailed surveys of Fire Stations and collected data though individual "Fire Station Survey Form" and Fire Headquarter Data Collection Form" as shown in Annexure 1 & 2. The collected information for each Fire Station are following categories.

1. Fire Station General Information
2. Fire Station Infrastructure Details
3. Communication Systems
4. Water Supply Details for Firefighting Purpose
5. Human Resources
6. Fire Risk Covered in the Area under Jurisdiction
7. Status of Firefighting Vehicles
8. Specialized equipments provided (specify whether kept in vehicle or in stores)
9. Other Accessories
10. Fire Calls and other Incidence Statistics (last 3-5 years)

Besides the collection of field survey data, RMSI team has also collected the location coordinates (latitude, longitude) of Fire Stations using GPS. The geographical coordinate information is used for plotting all the Fire Station locations in the map to perform GIS based spatial analysis. This is also used in the analysis of distribution of new proposed Fire Stations and gap analysis on fire-infrastructure, based on risk-category, response time, and population.

12.4 Infrastructure Gap analysis

12.4.1 Fire Station Gap Analysis

As discussed in section 6.2.5, ideal jurisdiction area has been demarcated for Andaman & Nicobar Police Fire Service. Depending upon the risk category, the recommended response time for first fire tender is 5 - 7 minutes in urban areas. Whereas, the response time for first fire tender is 20 minutes in rural areas. The analysis shows that Union Territory of Andaman and Nicobar Islands requires an additional **six** Fire Stations in addition to the operational ones (Figure 12-7 to 12-9 and Tables 12-4 to 12-5).

Table 12-4: Number of operational and additional Fire Stations required in Andaman Nicobar Islands

Operational Fire Stations	Additional Fire Stations
20	6

At present, there is an overall deficiency of **23%** in terms of number of Fire Stations in Andaman and Nicobar Islands.

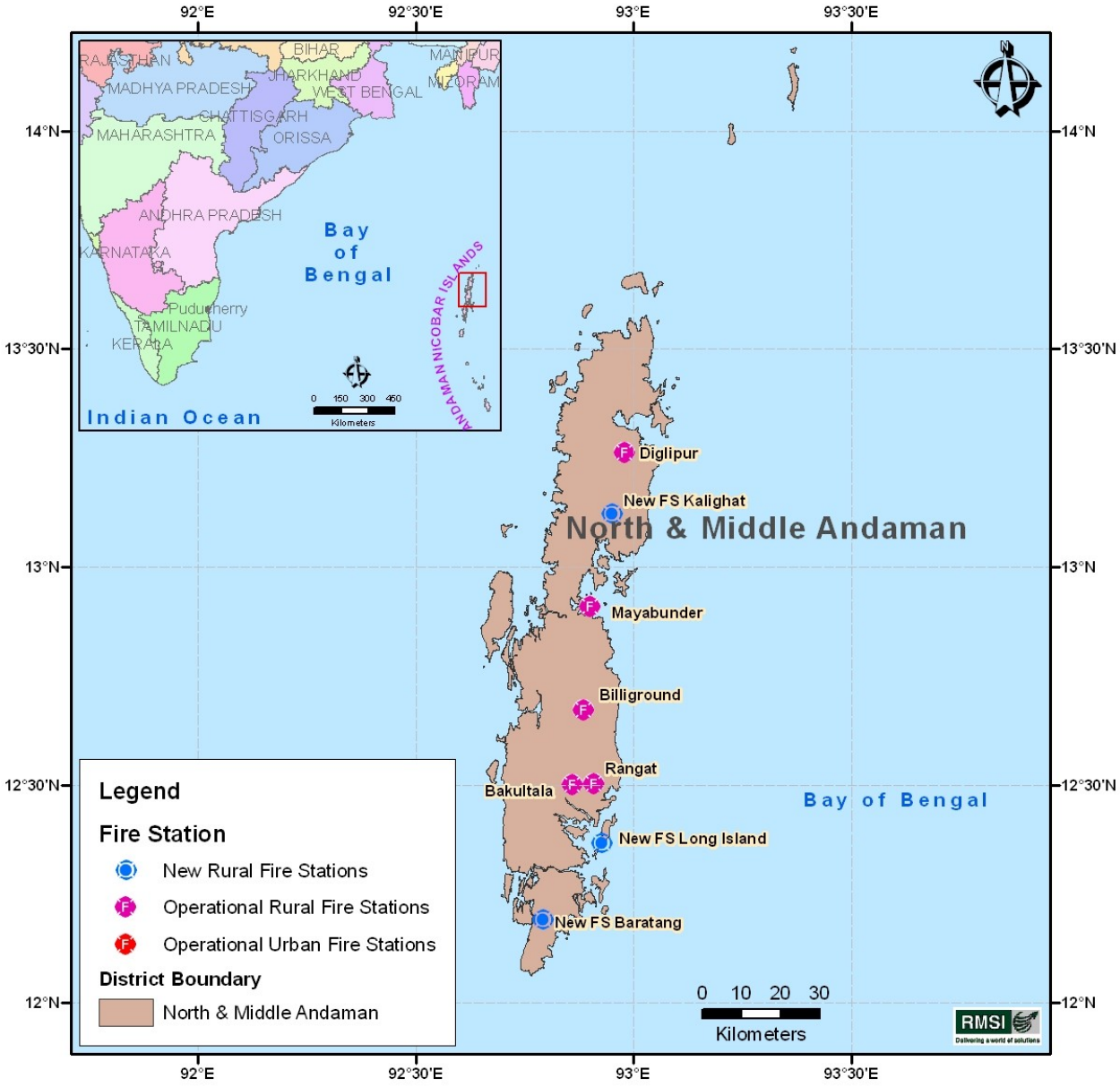

Figure 12-7: Location of operational and new proposed Fire Stations in North and Middle Andaman district

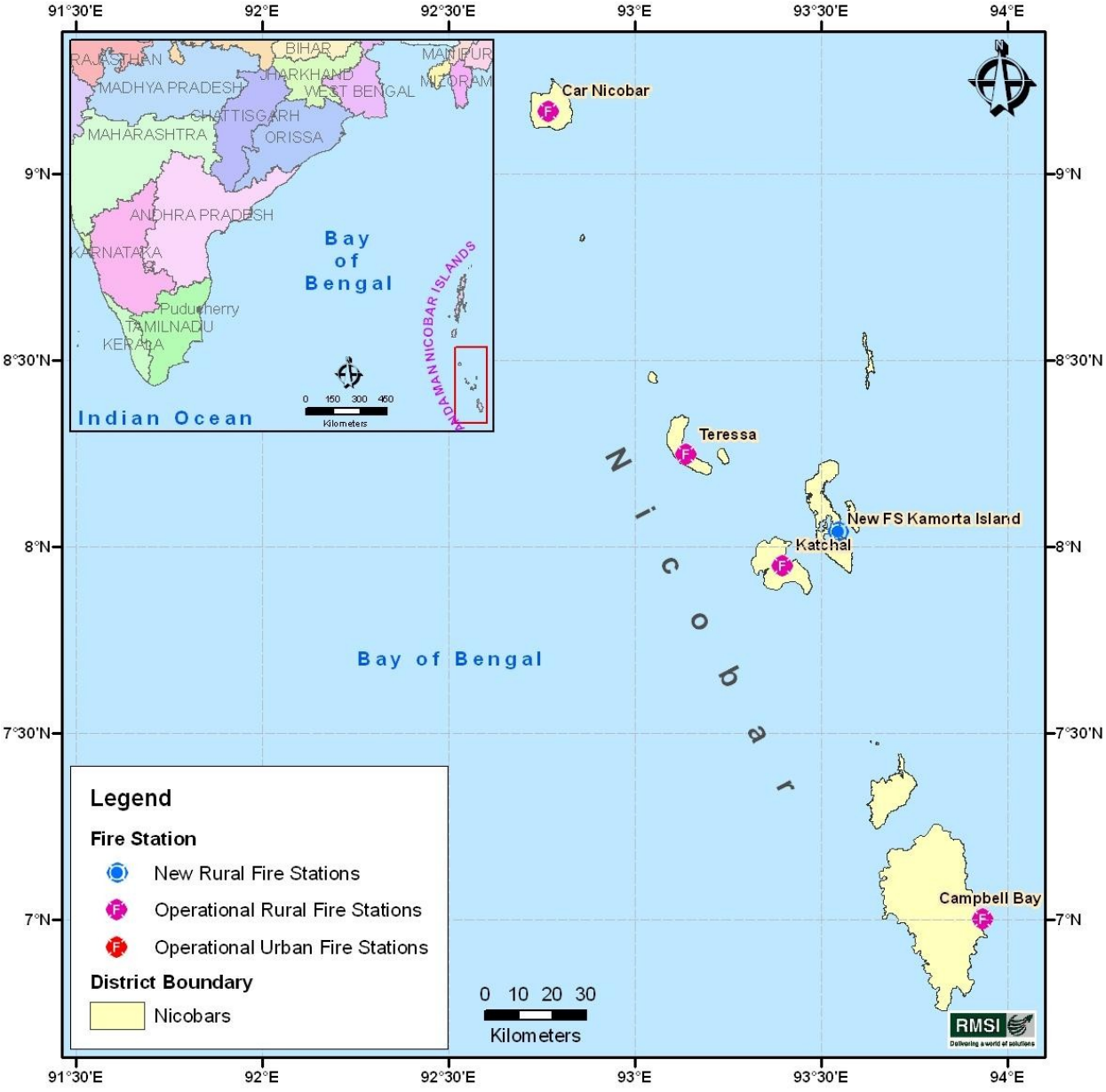

Figure 12-8: Location of operational and new proposed Fire Stations in Nicobar district

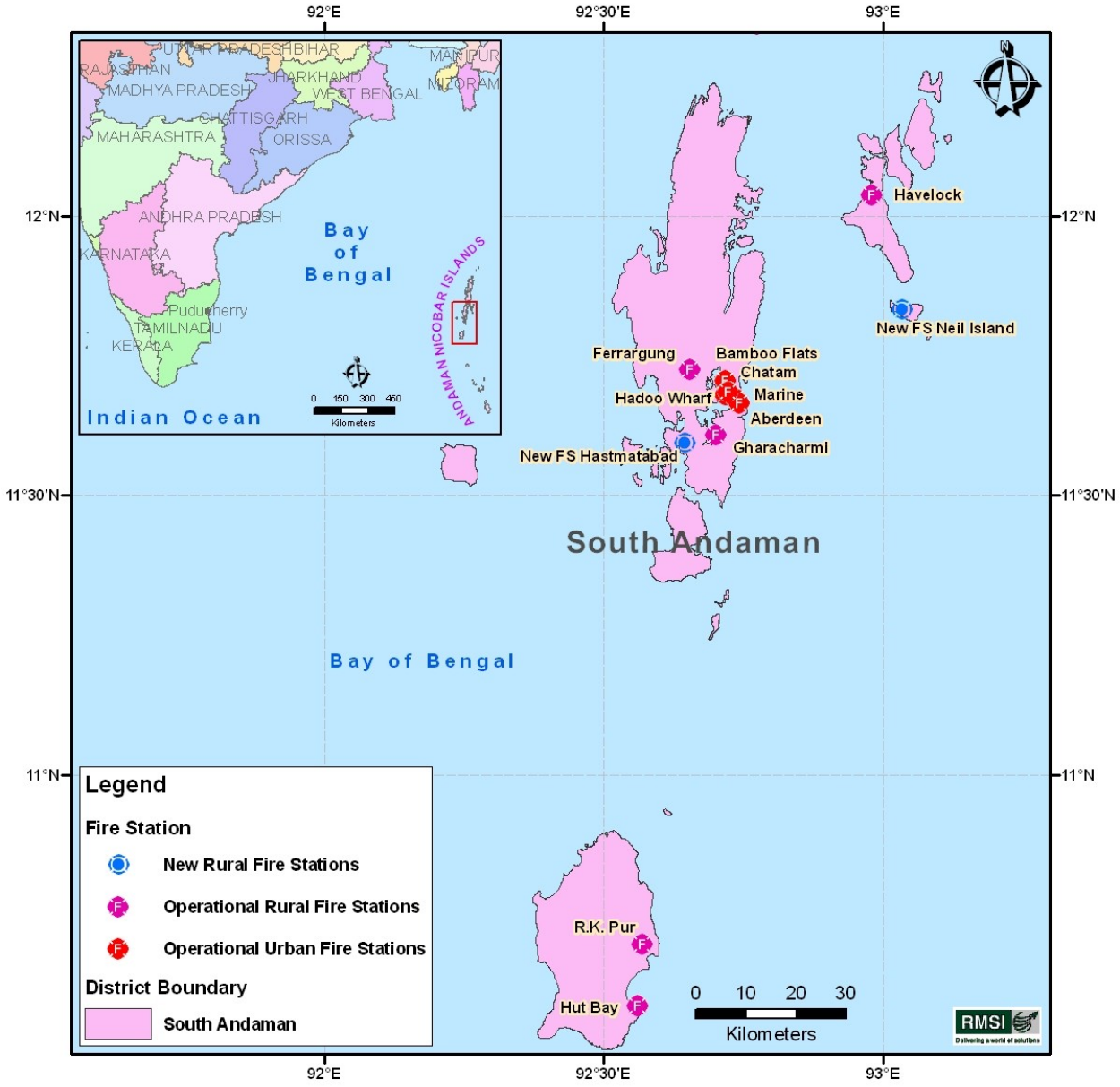

Figure 12-9: Location of operational and new proposed Fire Stations in Nicobar district

Table 12-5: Details of operational and additional Fire Stations required for Andaman and Nicobar Islands

Sl No	District	Fire Station Name	Town/ City / Locality Name	Fire Station/ Post Class
1	Nicobars	Campbell Bay Fire Station	Campbell Bay	Operational Rural Fire Stations
2	Nicobars	Car Nicobar Fire Station	HQ Car Nicobar	Operational Rural Fire Stations
3	Nicobars	Katchal Fire Station	Katchal	Operational Rural Fire Stations
21	Nicobars	New FS Kamorta Island	Kamotra	New Rural Fire Stations
4	Nicobars	Teressa Fire Station	Teressa	Operational Rural Fire Stations
5	North & Middle Andaman	Bakultala Fire Station	Rangat	Operational Rural Fire Stations
6	North & Middle Andaman	Billiground Fire Station	Billiground	Operational Rural Fire Stations
7	North & Middle Andaman	Diglipur Fire Station	Diglipur	Operational Rural Fire Stations
8	North & Middle Andaman	Mayabunder Fire Station	Mayabunder	Operational Rural Fire Stations
24	North & Middle Andaman	New Fire Station Long Island	Long Island	New Rural Fire Stations
22	North & Middle Andaman	New FS Baratang New FS	Baratang	New Rural Fire Stations
23	North & Middle Andaman	New FS Kalighat	Kalighat	New Rural Fire Stations
9	North & Middle Andaman	Rangat Fire Station	Rangat	Operational Rural Fire Stations
10	South Andaman	Aberdeen Fire Station	Port Blair	Operational Urban Fire Station
11	South Andaman	Bamboo Flats Fire Station	Bamboo Flats	Operational Urban Fire Station
12	South Andaman	Chatam Fire Station	Port Blair	Operational Urban Fire Station
13	South Andaman	Ferrargung Fire Station	Ferrargung	Operational Rural Fire Stations
14	South Andaman	Gharacharmi Fire Station	Port Blair	Operational Rural Fire Stations
15	South Andaman	Hadoo Wharf Fire Station	Port Blair	Operational Urban Fire Station
16	South Andaman	Havelock Fire Station	Havelock	Operational Rural Fire Stations
17	South Andaman	Hut Bay Fire Station	Hut Bay	Operational Rural Fire Stations
18	South Andaman	Kadamtala Fire Station	Kadamtala	Operational Rural Fire Stations
19	South Andaman	Marine Fire Station	Port Blair	Operational Urban Fire Station
26	South Andaman	New Fire Station Hastmatabad	Hastmatabad	New Rural Fire Stations
25	South Andaman	New FS Neil Island,	Neil Island	New Rural Fire Stations
20	South Andaman	R.K. Pur Fire Station	R.K. Pur	Operational Rural Fire Stations

12.4.1.1 Firefighting and Rescue Vehicles and Equipment Gap

For Firefighting and Rescue Vehicles and Equipment gap analysis at the operational Fire Stations and the additional (Table 12-5) Fire Stations in urban areas and Fire Stations/Fire Posts in rural areas, the following criteria have been followed, which have been basically taken from SFAC norms and minor changes have been made with expert opinion, for optimization of resources.

1. **Pumping Unit:** For counting of existing pumping units at various Fire Stations, equipments such as Fire Tender, Water Bowser, Water Mist Mini Fire Tender, Foam Tender, Crash Fire Tender, Fire Engine, Jumbo Tanker, and Multi-purpose Tender have been counted as one pumping unit. The SFAC criteria with some modifications have been proposed for estimating the requirement of pumping units. Accordingly, one pumping unit per 50,000 populations (subject to minimum one) up to 3 Lakhs population has been considered. For population of more than 3 Lakhs, one additional pumping unit per Lakhs of population has been considered. For example, if the population is 3,50,000 or more but less than 4,50,000, there should be 7 pumping units. At Fire Stations, where pumping unit requirements are coming to 2 or more units, half the units will be Water Tender and half the units will be Water Bowser, for example, for 2 pumping unit requirement, one will be Water Tender and one Water Bowser, however, for 3 pumping unit requirement, 2 will be Water Tender and 1 will be Water Bowser. *However, in hilly States, the criteria have been further relaxed.*

   Note: *We have considered pumping unit as a complete unit with water carrying capacity pumping unit, however, trailer fire pump with towing vehicle or a jeep fire engine, QRT with mist unit, or motor cycle with mist set have not been considered as a pumping unit. QRT with mist unit or motor cycle with mist set has been considered as a unit to cut response time in congested areas in urban areas.*

2. **Foam Tender:** For those Fire Stations, in whose jurisdiction small industrial area also lie, one Water Tender should be replaced with Foam Tender.
3. **DCP Tender:** Minimum one per district or one for 8-10 Fire Stations. Fire Stations having a large industrial plot area (in their ideal jurisdiction of above) 1.0 - 3.0 sq km, should have additionally one DCP tender. For industrial areas more than 3.0 sq km to 6.0 sq km, there should be two DCP Tenders and so on.
4. **Advanced Rescue Tender:** One per district (minimum) up to 10 Lakhs population, and one additional unit for every 10 Lakhs urban population.
5. **Hydraulic Platform/ALP/TTL:** 1 per district (minimum) depending upon the presence of high-rise buildings (height more than 15 m). Additional unit is to be provided for districts having a large number of such building blocks, i.e., Central Business Districts. *It may be noted that ALP/TTL is not a replacement for in-built systems in high-rise buildings. Moreover, equipment is heavy and maneuvering on roads becomes difficult, where there are overhead electrical lines.*
6. **HAZMAT Van:** Hazmat van is used rarely and is a very costly equipment requiring highly trained manpower. Hence, to optimize on resources and manpower, a HAZMAT van is not recommended for future procurement in the Andaman & Nicobar Police Fire Service. However, for that purpose, an Advanced

Rescue Responder is proposed (at Sr. No 4), which will have equipment to handle hazardous material release.

7. **Crash Fire Tender:** Crash fire Tender is not recommended for State Fire Services. Instead, for Fire Stations in the funnel area on either side of the airport, one WT should be replaced with Foam Tender depending upon the State policy.
8. **BA Van, Light Van and Control Van:** One each per district. However, to optimize on resources and manpower, we are proposing a BA Van- cum-Light Van – cum- Control Van.
9. **Hose Tender:** One per district (minimum) or one for 8-10 Fire Stations.
10. **Trailer Pump:** Though Trailer Pumps are prescribed in SFAC norms, it is not recommended for future use, as this needs an additional towing vehicle. In place of this, procurement of Portable Pump are recommended, which will be part of a Fire Tender (Specialized Equipment 12).
11. **QRT:** One each at Fire Stations serving a population density (total population in the FS jurisdiction/area of jurisdiction, in sq km) above 30,000 persons/sq km in metro and big cities, above 15,000 persons/sq km in other cities, or in congested areas based on field-survey.

    Note: The criteria of population density has been relaxed for hilly State from 15,000 person/sq km (in plains) to 5,000 person/sq km in the Fire Station jurisdiction.
12. **Motorcycle with two water mist sets:** One each at Fire Stations serving higher population density or in congested areas with each QRT.
13. **Fire Boat:** One each at selected Fire Stations, in whose jurisdiction some inhabitated areas exist near water bodies, such as lake, major river, sea, where firefighting can be better performed, through watercourse.
14. **Ambulance:** It is seen that Ambulance services are also with some of the State fire services and in few other States this is looked after by the Ministry of Health department of the States e.g., Rajasthan State has a modern fleet of Ambulances (108), well equipped with GPS, medical equipments and staff under National Rural Health Mission (Rajasthan), CATS (Centralized Accident Trauma Service, Ministry of Health) in case of Delhi State.

    It is observed during visit to the Fire Stations by the RMSI team that wherever the Ambulance are available with fire services, they neither have the Paramedic staff, nor adequate life support/normal equipments, and cannot be considered as an efficient system. It is therefore felt that either ambulance service should be run by Health Department through various hospitals / health centers or provide fully trained staff to fire services with properly equipped Ambulances. Accordingly, cost of the ambulance is not included in the gap analysis of the present study. However, the ambulance cost may be added, in case, it is decided in a particular State that Ambulance service should be part of fire services.

15. **Educational Van**: One per district and one additional unit for every 30 Lakhs district population.

At rural Fire Station/ Fire Post, if the estimated pumping unit is two, then one water tender with a QRT on pickup truck having 500 - 600 liters of water mist capacity along with a motor cycle with two water mist backpacks will be provided. This will help in quick response, as majority of rural villages inside roads are small in width and congested. This will also help in optimization of resources. For rural Fire Stations/ Fire Posts where less than 10,000 persons are residing within its jurisdiction, QRT and motor cycle with two water mist backpacks has only been recommended.

It may be noted that if a fire is responded to immediately, it may not flare-up into large fire; hence, QRT and Motorcycle are being considered as a quick responder and not as full-fledged fire units. In case of large fires, nearby Fire Station(s) will provide support with Water Tenders and Water Bowsers.

For reserve requirement, RMSI estimated reserve requirement of 20% at district level, and these will be distributed to individual Fire Stations by the concerned fire officials. This will help in optimizing the additional requirements of minimum one reserve at each Fire Station.

Accordingly, Firefighting vehicles available with Andaman & Nicobar Police Fire Service and gaps for the existing and ideally proposed Fire Stations in all the districts have been estimated and are shown in Tables 12.6, 12.7, and 12.8 respectively.

Table 12-6: List of operational firefighting vehicles available with Andaman & Nicobar Fire Service (As on Aug-Sep, 2011)

District	Fire Stations	Ideally Served Population Estimates	Water Tenders	Water Bowsers	Foam Tenders	Advanced Rescue Responders	Sky Lifts / TTL	DCP Tenders	Hose Tenders	BA Vans	Hazmat Vans	QRT	Motor Cycle Mists	Fire Boats	Ambulances	Education Vans	Total Vehicle
Nicobar	4	30,908	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
North and Middle Andaman	5	80,440	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
South Andaman	11	217,719	15	3	1	0	0	0	1	0	0	0	0	0	0	0	20
Total	**20**	**329,067**	**27**	**3**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**32**

Table 12-7: Vehicle gap in operational Fire Stations for their ideal jurisdiction area

District	Fire Stations	Ideally Served Population Estimates	Water Tenders	Water Bowsers	Foam Tenders	Advanced Rescue Responders	Sky Lifts / TTL	DCP Tenders	Hose Tenders	BA Vans	Hazmat Vans	QRT	Motor Cycle Mists	Fire Boats	Ambulances	Education Vans	Total Vehicle
Nicobar	4	30,908	0	1	0	1	0	0	1	1	0	4	4	0	0	1	13
North and Middle Andaman	5	80,440	0	1	1	1	0	0	1	1	0	5	5	0	0	1	16
South Andaman	11	217,719	5	4	2	1	0	0	1	1	0	11	11	2	0	1	39
Total	**20**	**329,067**	**5**	**6**	**3**	**3**	**0**	**0**	**3**	**3**	**0**	**20**	**20**	**2**	**0**	**3**	**68**

Table 12-8: Total gap in firefighting vehicles in operational and new Fire Stations (As on Aug-Sep, 2011)

District	Fire Stations	Ideally Served Population Estimates	Water Tenders	Water Bowsers	Foam Tenders	Advanced Rescue Responders	Sky Lifts / TTL	DCP Tenders	Hose Tenders	BA Vans	Hazmat Vans	QRT	Motor Cycle Mists	Fire Boats	Ambulances	Education Vans	Total Vehicle
Nicobar	5	36,819	1	1	0	1	0	0	1	1	0	5	5	0	0	1	16
North and Middle Andaman	8	105,539	3	1	1	1	0	0	1	1	0	8	8	0	0	1	25
South Andaman	13	237,586	7	4	2	1	0	0	1	1	0	13	13	2	0	1	45
Total	**26**	**379,944**	**11**	**6**	**3**	**3**	**0**	**0**	**3**	**3**	**0**	**26**	**26**	**2**	**0**	**3**	**86**

Specialized Equipment:

Specialized equipments for Fire Stations in urban areas shall be provided as per the following criteria:

1. **Hydraulic Rescue Tool:** One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction including Hydraulic Cutter, Hydraulic Spreader, Hydraulic Pump, Power Wedge, and Hydraulic Rescue Ram depending upon the seismic Zone IV and V or minimum one per district.
2. **Combi-Tool:** One Combi-Tool set shall be provided with each fire-fighting vehicle.
3. **B.A. Set with BA Compressor:** Four B. A. Sets per firefighting vehicle with minimum one compressor per Fire Station.
4. **First Aid Box:** One for each firefighting vehicle (minimum two at each Fire Station) with regular replacement of expired medicines
5. **Thermal Imaging Camera:** One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction or, minimum one per district.
6. **Personal Protection Equipment (PPE):** One Set for each pumping unit or a minimum of two for each Fire Station.
7. **Hydraulic Chain Saw/Cutter for Wood:** One for each Fire Station.
8. **Electric/Petrol Chain Saw/Cutter for Wood:** One for each Fire Station.
9. **Electric/Petrol Chain Saw/Cutter for Concrete:** One for each Fire Station.
10. **Hand Held Gas Detector:** One piece per Vehicle.
11. **Victim Location Device (Acoustic**): One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction or, minimum one per district.
12. **Portable Pump:** One for each firefighting unit.
13. **Floating Pump**: One for each Fire Boat.
14. **Smoke Exhauster/PPV:** One per Fire Stations located in urban areas (minimum one per district).
15. **Pneumatic Lifting Bags:** One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction or minimum one per district.
16. **Diving Suit (Dry Type):** Two for each Fire Boat depending upon the Fire Stations located in extreme climatic condition where wet type of diving suit cannot be used.
17. **Diving Suit (Wet Type):** Two for each Fire Boat for Fire Stations located in normal climatic condition.
18. **Inflatable Lighting Tower:** One per Fire Station.
19. **High Capacity LED Torch Light:** One piece per vehicle.

Note: *Other smaller equipments such as ropes, Fireman Axe, Small Hammer, different Branches/Nozzles, Foam Compound has not been mentioned separately, as these are standard items for any Fire Station/post.*

For Rural Fire Station/Fire Post, following specialized equipment has been recommended:

1. **B.A. Set with BA Compressor:** Two B. A. set per firefighting vehicle with one compressor per Fire Station/post.
2. **Personal Protection Equipment (PPE):** One set per firefighting vehicle.
3. **Electric/Petrol Chain Saw/Cutter for Wood:** One per Fire Station/post.
4. **Hydraulic Chain Saw/Cutter for Wood:** One per Fire Station/post.
5. **Portable Pump:** One for each firefighting unit.
6. **Inflatable Lighting Tower:** One per Fire Station.
7. **High Capacity LED Torch Light:** One piece per firefighting vehicle.
8. **First Aid Box:** One per firefighting vehicle.

For reserve requirement, RMSI estimated reserve requirement of 20% at district level, and these will be distributed to individual Fire Stations by the concerned fire officials. This will help in optimizing the additional requirements of minimum one reserve at each Fire Station.

Communication Equipment:

For better coordination between Fire Station and firefighting staff, communication plays an important role. Hence, there is a need that each fire vehicle and Fire Station is equipped with a communication device. Accordingly, following communication equipments for urban Fire Station are recommended:

1. **Static Wireless Set (VHF):** 1 set at each Fire Station.
2. **Mobile Wireless Set (VHF):** 1 per vehicle.
3. **Walky-Talky:** 1 per vehicle.
4. **Megaphone:** One set per Fire Station/Fire Post.

Accordingly, specialized fire equipment and communication equipment available with Andaman & Nicobar Police Fire Service and gap analysis for all the districts in Andaman and Nicobar Islands UT has been carried out and is shown Tables 12.9,12.10, and 12.11.

Table 12-9: List of specialized equipment available with available with Andaman & Nicobar Fire Service Department (As on Aug-Sep, 2011)

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Nicobar	4	30,908	0	0	7	0	4	0	8	4	0	0	0	0	4	0
North and Middle Andaman	5	80,440	0	0	13	0	5	0	10	5	0	0	0	0	6	0
South Andaman	11	217,719	0	0	8	0	11	0	21	10	0	0	0	0	11	0
Total	**20**	**329,067**	**0**	**0**	**28**	**0**	**20**	**0**	**39**	**19**	**0**	**0**	**0**	**0**	**21**	**0**

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District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Sets	Mobile Wireless Sets	Walky Talky	Mega Phones	Total
Nicobar	4	30,908	0	0	0	0	4	0	0	4	5	6	0	46
North and Middle Andaman	5	80,440	0	0	0	0	4	0	0	5	6	7	0	61
South Andaman	11	217,719	0	0	0	0	9	0	0	11	19	18	0	118
Total	**20**	**329,067**	**0**	**0**	**0**	**0**	**17**	**0**	**0**	**20**	**30**	**31**	**0**	**225**

Table 12-10: Gap in major specialized firefighting equipment in operational Fire Stations

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Nicobar	4	30,908	5	8	43	5	10	5	-1	1	5	14	13	5	3	0
North and Middle Andaman	5	80,440	6	7	21	6	8	6	-1	1	6	13	8	6	1	0
South Andaman	11	217,719	14	29	143	14	31	14	11	4	14	42	39	14	19	2
Total	**20**	**329,067**	**25**	**44**	**207**	**25**	**49**	**25**	**9**	**6**	**25**	**69**	**60**	**25**	**23**	**2**

Continued..

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Sets	Mobile Wireless Sets	Walky Talky	Mega Phones	Total
Nicobar	4	30,908	0	0	4	4	1	13	0	1	8	4	5	156
North and Middle Andaman	5	80,440	0	0	5	5	2	8	0	1	2	5	6	122
South Andaman	11	217,719	0	4	11	11	5	39	0	3	20	9	14	506
Total	**20**	**329,067**	**0**	**4**	**20**	**20**	**8**	**60**	**0**	**5**	**30**	**18**	**25**	**784**

Table 12-11: Total gap in specialized equipment in operational and new Fire Stations

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Nicobar	5	36,819	5	8	47	6	12	5	0	2	6	15	13	5	4	0
North and Middle Andaman	8	105,539	6	7	33	9	14	6	2	4	9	16	8	6	4	0
South Andaman	13	237,586	14	29	151	16	35	14	13	6	16	44	39	14	21	2
Total	**26**	**379,944**	**25**	**44**	**231**	**31**	**61**	**25**	**15**	**12**	**31**	**75**	**60**	**25**	**29**	**2**

Continued..

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Sets	Mobile Wireless Sets	Walky Talky	Mega Phones	Total
Nicobar	5	36,819	0	0	5	4	2	14	0	2	9	6	6	176
North and Middle Andaman	8	105,539	0	0	8	5	5	11	0	4	5	11	9	182
South Andaman	13	237,586	0	4	13	11	7	41	0	5	22	13	16	546
Total	**26**	**379,944**	**0**	**4**	**26**	**20**	**14**	**66**	**0**	**11**	**36**	**30**	**31**	**904**

12.4.1.2 Fire Manpower Gap

SFAC guidelines have suggested manpower, including reserve for duty off, training, leave for Station Officer, Sub-Officer (75%) and Leading Firemen and lower staff (25%). This has been further estimated for two shifts for Leading Firemen and lower staff, as duty patter for them is practically two-shift system (Table 12-12).

Table 12-12: Manpower requirement for Station officer and lower staff as per SFAC norm (double shift)

Sr No	Size of Station (Pumping Unit)	Station Officer	Sub-Officer *	Leading Firemen (L.F.)	Additional LFM	Total LFM	Drivers/ Operators	Firemen	Additional FM per FS (FAD,HID, DISP,WRO)	Total Firemen	Total
1	**One**	**0**	**1.75**	2.5	1.25	**3.75**	**5**	15	10	**25**	**35.50**
2	**Two**	**1.75**	**1.75**	5	1.25	**6.25**	**7.5**	30	10	**40**	**57.25**
3	**Three**	**1.75**	**3.5**	7.5	1.25	**8.75**	**10**	45	10	**55**	**79.00**
4	**Four**	**3.5**	**3.5**	10	1.25	**11.25**	**15**	60	10	**70**	**103.25**
5	**Five**	**3.5**	**5.25**	12.5	1.25	**13.75**	**17.5**	75	10	**85**	**125.00**
6	**Six**	**3.5**	**7**	15	1.25	**16.25**	**22.5**	90	10	**100**	**149.25**
7	**Seven**	**5.25**	**7**	17.5	1.25	**18.75**	**25**	105	10	**115**	**171.00**

**: Where extent of fire risk may justify Sub-Officers may be replaced with Station Officers*

The Administrative Reform Department (ARD, Delhi) has suggested following fire manpower including reserve duty off, training, leave for Station Officer and lower staff at 25% (Table 12-13).

Table 12-13: Manpower requirement for Station officer and lower staffs for Andaman & Nicobar Police Fire Service (double shift)

Sr No	Fire Station (Pumping Unit)	Station Officer	Sub-Officer	LFM	Firemen-cum-Driver-cum Operator	Total Staff
1	One	0	2.5	2.5	15.625	**20.6**
2	Two	1.25	2.5	2.5	31.250	**37.5**
3	Three	1.25	3.75	7.5	46.875	**59.4**
4	Four	2.5	4.6875	9.375	60.000	**76.6**
5	Five	2.5	5.625	11.25	73.125	**92.5**
6	Six	3.75	6.5625	13.125	87.188	**110.6**
7	Seven	3.75	7.5	15	101.250	**127.5**

From above, it is quite clear that The Administrative Reform Department (ARD, Delhi), has already optimized the fire manpower requirement in comparison of what has been suggested in SFAC norms. It may be noted that total number of staff is coming in decimal places, as calculations are on pumping units including reserve staff, which has been rounded of in the fire manpower gap analysis at district and UTs levels.

In addition to firefighting staff, there is an urgent need of fire prevention staff for inspection, awareness generation and training, so that recurrence of the fire incidences, similar to that at the Advance Medical Research Institute (AMRI), Kolkata, in terms of their magnitude and frequency can be reduced. Accordingly, additional staff at Assistant Divisional Officer (ADO) and above levels have been suggested:

There shall be one Deputy Director, one CFO and two Deputy CFO in the UT. There shall be one Divisional Fire Officer (DFO) per 6-8 Fire Stations.

There shall be one ADFO (Inspector Fire Brigade) per 3-4 Fire Stations subject to a minimum of one per district.

The CFO, DFO and ADFO include staff for Fire Prevention (Inspection, Awareness, Training).

For rural Fire Station/post, there will be a total firefighting staff of 6 persons on QRT with 3 persons per shift (i.e., 1 Sub-Officer, 1 Leading Fireman, 1 Fireman-cum-driver-cum-Operator). On Motorcycle, there will be a total staff of 4 persons with 2 persons per shift (1 sub-officer and 1 Fireman-cum-driver-cum-Operator). The requirement of reserve (leave, training, and contingent) shall be calculated at the rate of 25% of the district requirement and should be distributed accordingly.

It may be noted that for cleaning staff, we recommend hiring of Cleaners on contract basis. For computation in financial analysis, we have assumed a fixed salary of Rs 7,000/pm, and without any reserve over that.

Accordingly, existing fire manpower and gap analysis for all the districts in Andaman and Nicobar Islands have been carried out and are shown in Tables 12-14, 12-15 and 12-16.

Table 12-14: List of fire Manpower available with Andaman & Nicobar Police Fire Service Department (As on Aug-Sep, 2011)

District	Num of FS	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Nicobar	4	0	0	0	0	0	1	3	2	11	70	8	95
North and Middle Andaman	5	0	0	0	0	0	1	4	2	17	83	8	115
South Andaman	11	0	1	0	0	0	1	9	8	35	193	19	266
Total	**20**	**0**	**1**	**0**	**0**	**0**	**3**	**16**	**12**	**63**	**346**	**35**	**476**

***Level 10**: Director/ Deputy Director; **Level 9**: CFO/ CO; **Level 8**: Deputy CFO/Joint Director; **Level 7**: AD/Deputy Controller/ /DO; **Level 6**: DFO/ Inspector/EO/Fire Supervisor; **Level 5**: ADFO/AFO/Fire In-charge; **Level 4**: St.O/Sub Inspector/Station In-charge/ASt O./AEO; **Level 3**: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/; **Level 2** : LFM/ Mechanic Driver/Head Constable/Store Superintendant; **Level 1** : FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk; **Level 0:** Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Table 12-15: Manpower gap in operational Fire Stations for ideal jurisdiction area

District	Num of FS	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Nicobar	4	0	0	0	0	1	0	2	17	27	114	-4	157
North and Middle Andaman	5	0	0	1	0	1	0	2	20	26	118	-3	165
South Andaman	11	1	0	1	0	2	3	10	45	77	381	-8	512
Total	**20**	**1**	**0**	**2**	**0**	**4**	**3**	**14**	**82**	**130**	**613**	**-15**	**834**

Table 12-16: Total staff gap in operational and new Fire Stations

District	Num of FS	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Nicobar	5	0	0	0	0	1	0	2	20	33	135	-3	188
North and Middle Andaman	8	0	0	1	0	1	0	2	30	45	180	0	259
South Andaman	13	1	0	1	0	2	4	10	52	90	422	-6	576
Total	**26**	**1**	**0**	**2**	**0**	**4**	**4**	**14**	**102**	**168**	**737**	**-9**	**1,023**

***Level 10**: Director/ Deputy Director; **Level 9**: CFO/ CO; **Level 8**: Deputy CFO/Joint Director; **Level 7**: AD/Deputy Controller/DO; **Level 6**: DFO/ Inspector/EO/Fire Supervisor; **Level 5**: ADFO/AFO/Fire In-charge; **Level 4**: St.O/Sub Inspector/Station In-charge/ASt O./AEO; **Level 3**: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/; **Level 2** : LFM/ Mechanic Driver/Head Constable/Store Superintendant; **Level 1** : FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk; **Level 0:** Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Cleaner, Tindal.*

12.5 Investment and Financial Analysis

12.5.1.1 Capital Cost

Building Infrastructure Cost:

Tables 12-17 provide details of the additional number of new Fire Stations in terms of number of bays required in Andaman and Nicobar Islands UT.

Table 12-17: Details of additional Fire Stations building (with number of bays) required at district level

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7
Nicobar	5	0	1	0	0	0	0	0
North and Middle Andaman	8	0	5	0	1	0	0	1
South Andaman	13	0	3	2	1	0	0	0
Total	**26**	**0**	**9**	**2**	**2**	**0**	**0**	**1**

The ideal requirement of land in Andaman and Nicobar Islands UT for a Fire Station is 2 ½ acres. It may be noted that land cost will vary from place to place and time to time; hence, land cost has not been added in cost estimates. The civil construction cost estimation involves cost of Fire Station building including stores, offices, residential quarters, static water tanks, which will vary in size depending upon the number of bays (garage) in a Fire Station. In Andaman and Nicobar Islands, due to remoteness, inaccessibility, high land development cost, labor cost, the overall construction cost for Fire Station building is considerably high compared to the mainland of India. Accordingly, total cost estimates for one, two, three, five, and seven bay Fire Stations (based on Andaman P.W. D. norms) is about 300 Lakhs, 600 Lakhs, 900 Lakhs, 1,400 Lakhs, 1,900 Lakhs respectively (Table 12-18).

Table 12-18: Capital building Cost (In Lakhs Rupees) for additional Fire Stations

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7
Nicobar	5	0.00	300.00	0.00	0.00	0.00	0.00	0.00
North and Middle Andaman	8	0.00	1500.00	0.00	575.00	0.00	0.00	950.00
South Andaman	13	0.00	900.00	900.00	575.00	0.00	0.00	0.00
Total	**26**	**0.00**	**2700.00**	**900.00**	**1150.00**	**0.00**	**0.00**	**950.00**

Thus, total estimated capital cost for the Fire Stations building development for all the new Fire Stations is **Rs. 57Crores**.

Vehicles and Equipment Cost: The costs of different fire vehicles and specialized equipments including communication sets (static and mobile VHF sets) have been taken as approximate rates quoted by fire equipment supplier. As Andaman and Nicobar Islands is located far from mainland, due to the increase in transportation cost, overall estimated vehicle and maintenance cost is higher than mainland of India. Accordingly, capital cost for fire vehicles and equipments for all the districts in Andaman & Nicobar Police Fire Service have been estimated (Tables 12-19, 12-20).

Table 12-19: Cost estimates (in Lakhs Rupees) for gap in firefighting vehicles in operational and new Fire Stations

District	Fire Stations	Water Tenders	Water Bowsers	Foam Tenders	Advanced Rescue Responders	Sky Lifts / TTL	DCP Tenders	Hose Tenders	BA Vans	QRT	Motor Cycle Mists	Fire Boats	Education Vans	Total Vehicle
Nicobar	5	35.0	30.0	0.0	500.0	0.0	0.0	30.0	30.0	45.0	33.8	0.0	20.0	723.8
North and Middle Andaman	8	105.0	30.0	40.0	500.0	0.0	0.0	30.0	30.0	72.0	54.0	0.0	20.0	881.0
South Andaman	13	245.0	120.0	80.0	500.0	0.0	0.0	30.0	30.0	117.0	87.8	30.0	20.0	1259.8
Total	**26**	**385.0**	**180.0**	**120.0**	**1500.0**	**0.0**	**0.0**	**90.0**	**90.0**	**234.0**	**175.5**	**30.0**	**60.0**	**2,864.5**

Table 12-20: Capital cost estimates (in Lakhs Rupees) for major specialized fire and communication equipment for gap in operational and new Fire Stations

State	Fire Stations	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Nicobar	5	75.0	20.0	18.8	9.0	1.2	50.0	0.0	1.0	1.8	37.5	3.9	32.5	8.0	0.0
North and Middle Andaman	8	90.0	17.5	13.2	13.5	1.4	60.0	1.6	2.0	2.7	40.0	2.4	39.0	8.0	0.0
South Andaman	13	210.0	72.5	60.4	24.0	3.5	140.0	10.4	3.0	4.8	110.0	11.7	91.0	42.0	2.0
Total	**26**	**375.0**	**110.0**	**92.4**	**46.5**	**6.1**	**250.0**	**12.0**	**6.0**	**9.3**	**187.5**	**18.0**	**162.5**	**58.0**	**2.0**

Continued…

State	Fire Stations	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Sets	Mobile Wireless Sets	Walky Talky	Mega Phones	Total
Nicobar	5	0.0	0.0	10.5	4.0	10.0	5.6	0.0	0.5	1.5	0.7	1.8	293.4
North and Middle Andaman	8	0.0	0.0	16.8	5.0	25.0	4.4	0.0	1.1	0.9	1.3	2.7	348.5
South Andaman	13	0.0	8.0	27.3	11.0	35.0	16.4	0.0	1.4	3.7	1.6	4.8	894.5
Total	**26**	**0.0**	**8.0**	**54.6**	**20.0**	**70.0**	**26.4**	**0.0**	**3.0**	**6.1**	**3.6**	**9.3**	**1,536.3**

Total estimated capital cost gap for fire vehicles (including educational van), specialized major equipments and communication equipments are **Rs. 44 Crores**.

Table 12-21: Annual cost estimates (in Lakhs Rupees) for manpower for Andaman and Nicobar Islands Fire Services after filling up the gap in operational and new Fire Stations

District	Num of FS	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Nicobar	5	0.00	0.00	0.00	0.00	6.40	0.00	10.10	86.00	109.23	437.40	-2.52	646.61
North and Middle Andaman	8	0.00	0.00	8.61	0.00	6.40	0.00	10.10	129.00	148.95	583.20	0.00	886.26
South Andaman	13	14.76	0.00	8.61	0.00	12.80	22.88	50.50	223.60	297.90	1,367.28	-5.04	1,993.29
Total	**26**	**14.76**	**0.00**	**17.22**	**0.00**	**25.60**	**22.88**	**70.70**	**438.60**	**556.08**	**2,387.88**	**-7.56**	**3,526.16**

***Level 10**: Director/ Deputy Director; **Level 9**: CFO/ CO; **Level 8**: Deputy CFO/Joint Director; **Level 7**: AD/Deputy Controller/DO; **Level 6**: DFO/ Inspector/EO/Fire Supervisor; **Level 5**: ADFO/AFO/Fire In-charge; **Level 4**: St.O/Sub Inspector/Station In-charge/ASt O./AEO; **Level 3**: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/; **Level 2** : LFM/ Mechanic Driver/Head Constable/Store Superintendant; **Level 1** : FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk; **Level 0:** Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Cleaner, Tindal.*

12.5.1.2 Recurring Costs

Manpower Cost

The fire manpower cost estimation per year have been carried out by taking into account pay-scale structure for different levels of employee. Accordingly, cost estimate for fire manpower gap at various levels is shown in Table 12-21.

The total estimated fire manpower cost for the gap in existing and proposed staff is about **Rs. 35.26 Crores** per year.

Annual Vehicle and Equipment Maintenance & Repairs, PDL, Office and Training Expenses

For Gap analysis, vehicle maintenance and repairs cost have been estimated based on the current expenditure of Andaman & Nicobar Police Fire Service Department on vehicle maintenance & repairs, and Petrol, Diesel & Lubricant (PDL). The total estimated cost on vehicle- equipment maintenance & repairs, and PDL will be **Rs. 2.83 Crores** per year for the total gap of firefighting vehicles.

Office expenditure (stationary, electricity, water, telephone, Internet etc.) and training expenses for gap have been estimated based on the current expenditure of Andaman & Nicobar Police Fire Service Department on office expenditure and training per year. The total estimated cost on office expenditure and training expenses is **Rs. 3.27 Crores** per year. The total estimated cost on annual building maintenance is **Rs. 1.45 Crores** per year (Table 12-22). The state level summary of Capital and Recurring Expenditure is shown in Table 12-23 and 12-24, respectively.

Table 12-22: Annual recurring cost estimates (in Lakhs Rupees) for PDL, various maintenance and training expense after filling the gap in operational Fire Stations

District	Num of Fire Stations	Annual Vehicle maintenance	Annual PDL Cost	Annual Equipments maintenance	Annual Building Maintenance	Office Expenses	Training Expenses
Nicobar	4	21.19	15.89	25.42	21.00	53.20	9.29
North and Middle Andaman	5	22.53	16.90	27.70	45.50	59.43	10.38
South Andaman	11	44.24	33.18	76.81	78.50	166.09	29.00
Total	**20**	**87.96**	**65.97**	**129.93**	**145.00**	**278.72**	**48.67**

Table 12-23: State level summary of Capital Expenditure required for filling the gap (in Crores Rupees)

Capital Expenditure				
Operational Type	Fire Station Building Infrastructure	Vehicles Cost	Equipments Cost	Total Capital Cost
Operational Fire Stations	33.50	11.05	1.95	46.50
Gap in Operational Fire Stations	39.00	25.60	14.29	78.89
New Rural Fire Stations	0.00	0.00	0.00	0.00
Total Gap in New Urban ,New Rural and Operational Fire Stations	39.00	25.60	14.29	78.89

Table 12-24: State level summary of Recurring Expenditure required for filling the gap (in Crores Rupees)

Recurring Expenditure								
Operational Type	Annual Staff Salary	Annual Vehicle Maintenance	Annual Maintenance Contract (Specialized Equipment)	Annual Petrol diesel and Lubricant Cost	Annual Building maintenance	Annual Office Expenses	Annual Training Expenses	Total Recurring Expenditure
Operational Fire Stations	15.22	0.27	0.16	0.20	0.67	0.96	0.17	17.64
Gap in Operational Fire Stations	29.02	0.61	1.14	0.46	0.78	1.83	0.32	34.16
New Rural Fire Stations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Gap in New Urban ,New Rural and Operational Fire Stations	29.02	0.61	1.14	0.46	0.78	1.83	0.32	34.16

12.6 Detailed Roadmap for Investment Plan

All the above detailed capital and recurring expenses for Gaps in terms of construction of new Fire Station buildings, building maintenance, manpower, firefighting vehicles and equipment and their maintenance, training of manpower, etc. have been taken into consideration, while finalizing the detailed investment road map plan for next 10 years for Andaman and Nicobar Police Fire Service (Table 12-25).

A few assumptions have been made, while considering the detailed roadmap for investment plan in next 10 years:

- The first assumption is that the existing gaps in terms of manpower, firefighting vehicles, and equipments will be filled up in first two years.
- The second assumption is that 40% gaps in Fire Station buildings will be filled up in first two year, and subsequently 10% gap in each year.
- The third assumption is that the average annual rate on expenses on fire vehicle maintenance, petrol, diesel & lubricants, and office expenses, training, uniform will remain same as that in F.Y. 2010-11, however, on top of that an annual inflation factor will be of 8% (fire vehicle maintenance, petrol, diesel & lubricants), 5% (office expenses, training, uniform).
- The fourth assumption is that building construction cost will increase on an average by about 11% per year (construction cost index) and building maintenance cost by about 1% of total building construction cost as in 2010-11.
- The salary costs at each level have been estimated from the present pay scales for each level and on top of that an annual growth of 12% in subsequent years.

From Table 12-25 and 12-26, it can be seen that it will involve a total investment of about **Rs. 965 Crores** for filling gap in operational Fire Stations and **Rs. 1,072 Crores** for filling gap in operational and new Fire Stations spread over a period of 10 years for Union Territory of Andaman and Nicobar Islands. It may be noted that all the recurring expenses includes current salaries and all other expenses from first – years to all subsequent years for the next 10 years.

All the above detailed capital and recurring expenses for Gaps in Fire Station infrastructure have also been taken into consideration, while finalizing the detailed investment road map plan for next 10 years for Andaman & Nicobar Police Fire Service.

Table 12-25: State level 10 year investment plan for Andaman & Nicobar Police Fire Service for filling gap in operational Fire Stations (in Crores Rupees)

	Capital Expenditure		Recurring Expenditure					
Year	Building Infra structure	Vehicles and Equipments	Annual Vehicle Maintenance & PDL and AMC	Annual Staff Salary	Annual Office Expenses	Annual Training Office Expenses	Annual Bldg. maintenance	Annual Total
First Year	7.80	19.95	1.73	29.73	1.87	0.33	1.06	62.47
Second Year	8.66	20.94	3.07	49.55	3.12	0.51	1.46	87.31
Third Year	4.81	0.00	3.31	55.50	3.50	0.54	1.48	69.12
Forth Year	5.33	0.00	3.58	62.16	3.92	0.56	1.49	77.04
Fifth Year	5.92	0.00	3.86	69.61	4.39	0.59	1.51	85.88
Sixth Year	6.57	0.00	4.17	77.97	4.91	0.62	1.52	95.77
Seventh Year	7.29	0.00	4.50	87.32	5.50	0.65	1.54	106.82
Eighth Year	8.10	0.00	4.87	97.80	6.16	0.68	1.55	119.17
Ninth Year	0.00	0.00	5.25	109.54	6.90	0.72	1.57	123.98
Tenth Year	0.00	0.00	5.67	122.68	7.73	0.76	1.59	138.43
Total	**54.48**	**40.89**	**40.01**	**761.87**	**48.00**	**5.96**	**14.78**	**965.99**

Table 12-26: State level 10 year investment plan for Andaman & Nicobar Police Fire Service Gaps for filling gap in operational and new Fire Stations (in Crores Rupees)

	Capital Expenditure		Recurring Expenditure					
Year	Building Infra structure	Vehicles and Equipments	Annual Vehicle Maintenance & PDL and AMC	Annual Staff Salary	Annual Office Expenses	Annual Training Office Expenses	Annual Bldg. maintenance	Annual Total
First Year	11.40	19.95	1.73	29.73	1.87	0.33	1.06	66.07
Second Year	12.65	20.94	3.07	49.55	3.12	0.51	1.46	91.31
Third Year	7.02	0.91	3.36	57.06	3.59	0.55	1.55	74.05
Forth Year	7.80	0.95	3.68	65.66	4.14	0.60	1.64	84.47
Fifth Year	8.65	0.50	4.01	74.53	4.70	0.63	1.70	94.71
Sixth Year	9.61	0.53	4.36	84.57	5.33	0.67	1.75	106.81
Seventh Year	10.66	0.55	4.74	95.95	6.04	0.72	1.81	120.47
Eighth Year	11.83	0.58	5.16	108.84	6.86	0.76	1.86	135.90
Ninth Year	0.00	0.61	5.61	123.45	7.78	0.81	1.92	140.18
Tenth Year	0.00	0.64	6.10	140.00	8.82	0.86	1.98	158.40
Total	**79.63**	**46.15**	**41.82**	**829.35**	**52.25**	**6.44**	**16.74**	**1,072.38**

12.7 Prioritization of Fire Stations/Fire Posts

For prioritization of Fire Station, the RMSI team has strictly followed risk categorization and population as a criterion. The serial numbers in Tables 12-27 are as per Table 12-5.

It may be noted that actual implantation of priority depends upon number of factors such as land availability, land possession, tackling any encroachment on the available land, getting construction clearances from various authorities to implementation of construction work by PWD Department. Hence, Andaman and Nicobar Island Police Fire Service may change the priority of a Fire Station depending upon the local situation and requirements.

Table 12-27: Prioritization for establishing new rural Fire Station in Andaman and Nicobar Island UT

Sl No	District	Fire Station Name	Town/ City/ Locality Name	Fire Station Type
1	South Andaman	New Fire Station Hastmatabad	Hastmatabad	New Rural Fire Stations
2	North & Middle Andaman	New FS Kalighat	Kalighat	New Rural Fire Stations
3	North & Middle Andaman	New FS Baratang New FS	Baratang	New Rural Fire Stations
4	Nicobars	New FS Kamorta Island	Kamotra	New Rural Fire Stations
5	South Andaman	New FS Neil Island,	Neil Island	New Rural Fire Stations
6	North & Middle Andaman	New Fire Station Long Island	Long Island	New Rural Fire Stations

12.8 Avenues of Fund Generation

Andaman and Nicobar Island Police Fire Service can generate new avenues for funds from the followings:

- Introduction of Fire Tax (1% of existing property tax)
- Introduction of Fire Cess, which can be collected for auditing and inspecting various residential, commercial, and industrial occupancies for adoption of Fire Safety Measures besides training public manpower for use of first aid firefighting equipment
- Training programs at different levels and duration to private sector employee on chargeable basis
- Sale of condemned fire appliances, equipments, uniform articles and general store items
- Clearance of building plans from fire safety point of view

12.9 Capacity Building and Training Facilities

The state has framed Recruitment Rules (RR) for each level, and these are being adhered to for filling the vacant position. Andaman and Nicobar Police Fire Service Department also have a Fire Service Training Centre at its Headquarter (Aberdeen Fire Station, Port Blair) and imparts basic training to fire personnel.

The State Fire Service Training Centre (HQ) is located at Port Blair in South Andaman district. There are 11 faculties available for training of fire service manpower in the state (1 Inspector, 2 Sub-Inspector, 2 Instructor (HC) and 6 Demonstrator (PC)) (Table 12-28).

Table 12-28: Training Courses run by the State Fire Service Training Centre (HQ), Andaman and Nicobar Island UT

Sl No	Name of Training Course and Duration	Duration (months)	Maximum Capacity (persons)	Number of Personnel Trained Annually (w.e.f. 2006 – 2011)
1	Fireman Training Course	09	30	30
2	Leading Fireman	03	30	04
3	Refresher Training Course	01	30	156
4	Vocational Training Providers Course	03	30	35

Apart from the State Fire Service Training Centre (HQ), sub-officers and above are trained from National Fire Service College (NFSC, Nagpur) as wells as other state training centers located in Kolkata and Chennai (Table – 12-29).

Table 12-29: Training courses attend by fire-staffs in other centers outside state

Sl No	Type of Training	At NFSC, Nagpur	In other State Training Centers	Foreign Countries	Total Number of Personnel Trained (persons)
1	Sub Officer Course		Chennai/ Kolkata/ Delhi	-	14
2	Station Officer Course	NFSC		-	05
3	Divisional Officer Course	NFSC		-	02+02 person are still under training

As per the guidelines of SFAC, immediately after recruitment, fire personal should undertake professional training. Moreover, there should be refresher-training courses at an interval of 3 to 5 years for every fire personal. The following sections details about the estimation of training need at every level (fireman, leading fireman, station officer, sub-officer etc.).

12.9.1.1 Basic Training for Fireman

The basic training course should provide practical experience of firefighting to meet the challenge in firefighting operations. Fire personal should also be trained for operation and maintenance of firefighting vehicles and equipments.

Estimated number of fire personnel who require basic training for fireman in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 12-30. Additional requirement of Refresher Training Course for Fireman after 3-5 years service as fireman is also shown the Table 12-30. Some of the special training for specialized equipments such as Breathing Apparatus, Global-positioning system etc should also be part of the refresher course. As a whole, A&N Islands Fire Service would require to train 1,555 fire Personnel in basic and refresher training in next 10 years. Therefore, state training centre should have adequate capacity and infrastructure for meeting such training requirement.

Table 12-30: Estimated Training Requirements for Fire Personnel in A&N Islands Fire Service

Basic Training for Fireman		
	Num of Fire Personnel in Operational Fire Stations	717
	Num of Fire Personnel in New Fire Stations	124
	Total Num of Fire Personnel for Training	**841**
Refresher Training for Fireman		
	Total Num of Fire Personnel	**714**
Leading Fireman Training Course		
	Num of Fire Personnel in Operational Fire Stations	149
	Num of Fire Personnel in New Fire Stations	38
	Total Num of Fire Personnel for Training	**187**
Other specialized Training Course		
	Total Num of Fire Personnel for Training	**149**
Junior Officer Training Course		
	Num of Fire Personnel in Operational Fire Stations	104
	Num of Fire Personnel in New Fire Stations	20
	Total Num of Fire Personnel for Training	**124**
Divisional Officer Training Course		
	Num of Fire Personnel in Operational Fire Stations	10
	Num of Fire Personnel in New Fire Stations	1
	Total Num of Fire Personnel for Training	**11**
Fire Prevention Course		
	Total Num of Fire Personnel for Training	**14**

12.9.1.2 Training Course for Leading Fireman

While promotion from fireman to leading fireman, fire personal should undertake a training course for Leading Fireman. This training will provide both theoretical and practical training required for effective deployment of fire vehicles and fire equipment and personal. In case, A&N Islands Training Centre does not have adequate infrastructure and capacity, the Leading Fireman training should be provided at NFSC Nagpur, or any other suitable neighboring state training centre. .

Estimated number of fire Personnel who require training for leading fireman in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 12-30.

12.9.1.3 Other Specialized Training Courses

Besides normal training course for Leading Fireman, every Leading Fireman should also undergo at least one specialized training in due course of time. In many cases, fire services need to face new challenges and play an important role in other emergencies. Therefore, fire Personnel must be well trained to perform in all possible situations. Thus, it is important that they undergo other specialized training as well.

Following are some of the other specialized trainings courses:

- Breathing Apparatus
- Collapsed structure – Search & Rescue
- Advanced Search & Rescue
- Flood Rescue
- Chemical Disaster
- Flood / Cyclone Disaster Response
- Earthquake Disaster Response
- Hazardous Material Emergency

The syllabus of above courses are provided in SFAC guidelines. Number of leading fireman needed for specialized course is also shown in Table 12-30. In total, A&N Islands Fire Service would need to train at least 149 leading fireman for specialized course in next 10 years.

12.9.1.4 Junior Officer Training Course

While promotion from leading fireman to sub-officer/station officer, fire personal should undertake a Junior Officer Training Course. This course should provide an understanding of Fire Station administration, fire safety management and leadership as to be able to command a Fire Station. Upon successful completion of training, Fire officers will be able to identify components of an effective fire service organization and planning requirement. He will also be responsible for implementation of fire safety and prevention programs at their assigned Fire Station along with senior level officials.

Junior Officer Training Course should be undertaken at national training centre such as NFSC, Nagpur or upcoming state training centers. Every region comprising of few state may have a regional national training centre.

Estimated number of fire officers who require Junior Officer Training Course in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 12-30. After filling gap in operational Fire Stations and new urban and rural Fire Stations, A&N Islands Fire Service would require to train 124 junior officers in next 10 years.

12.9.1.5 Divisional Fire Officer Training Course

On promotion from station officer to sub-officer, every fire officer should undertake a Divisional Fire Officer (DFO) Training Course. This course should provide with theory, the principles and practice of Fire Station management, facilities, fire inspection as well as effective guidelines to command a fire crew and control at an incident site. This course should prepare them for their roles as senior fire officers. Upon successful completion of training, officer will be able to identify components of an effective fire service organization, and implementation of fire prevention and fire safety programs at their assigned Fire Station and its jurisdiction area.

Divisional Officer Training Course should be undertaken at national or international training institutes, such as NFSC, Nagpur or similar upcoming national training institute.

Estimated number of fire officers who require Divisional Officer Training Course in operational and new Fire Stations (after filling the gap of manpower) is shown in Table 12-30. There would be 11 divisional fire officers in A&N Islands Fire Service who would require this training in next 10 years.

12.9.1.6 Awareness Generation Programs

Fire Service Training Centre also carried out training and awareness programs imparted for 1,679 and 9,756 Government Servants, Students and Civilians during the years 2008, and 2009-2011, respectively.

For capacity development, each district is being recommended with an Education Van equipped with short video films as produced by MHA, distribution of pamphlets on “DO”s and “DON’T”s generated by MHA, and live- demonstrations of how to use “Portable Extinguishers” and handle small kitchen fires. Fire service should use these in their awareness generation programs.

12.10 Limitations of the Study

1. In fire hazard and risk analysis, fire-load of specific industry has not been taken into consideration. However, weightage has been given to the size of industrial area in the fire hazard and risk analysis of the base unit (district level). An attempt has been made even in the present assignment to go further down at lower levels. Providing special weightage of type of industry will require building level survey including estimation of fire-load for each industry, which is out of scope of present assignment.
2. Currently, Census 2011 has published only district level demographic data (the Tehsil/ Block level data is still unavailable), which has been used for further estimation and analysis purpose.
3. Floating population in cities has not been considered for distribution over the land use (built-up area); this may be attempted in future detailed studies.
4. Non-availability of a uniform level of fire statistics of all the fire events in the past 5 years.
5. Designation, rank structure and administrative control are very heterogeneous from state to state, which in the present state creates ambiguity while brining in at National level. For example, Director Position pay scale in one state may not be equal to that of Chief Fire Officer in another state. For the purpose of present assignment, we have divided the rank/designation structure into 11 levels (level 0 to level 10). For this, a system needs to be put in place through having a uniform administrative structure at national level to state level. This may require development and implementation of National Fire Act, which MHA is trying to develop in near future.
6. The firefighting infrastructure of forest department, privately owned companies/ organizations, military cantonment and airbases, nuclear power plants, nuclear research reactors, heavy water plants, mines, ports, airports, oil exploration and oil refineries are out of scope of present study. However, RMSI is trying to get information about the fire-fighting infrastructure for these, and will include whatever information will be available, as there are limitations due to security concerns. This is more so, as result of this study may be made available in public domain with their spatial location. Studying fire infrastructure in above areas will require special MOU's with MHA and controlling agencies, and may be attempted in future studies to have a complete coverage of the country.

12.11 Recommendations

1. Computerization of Andaman and Nicobar Police Fire Service with a dedicated website is required and need all the Fire Stations to be connected through INTRANET.
2. Online Vehicle tracking through GPS and development of a fully computerized response system is another area for improvement.
3. Training of fire personnel in use of computers is another aspect, which is very important from the modernization of fire services point of view.
4. Andaman and Nicobar Police Fire Service needs to establish a well-equipped model workshop to take care of day-to-day repairs of fire vehicles. Because of the lack of connectivity of other stations with headquarter by road, there is need to have special arrangement for repairing staffs in for quick repairs.
5. Though Andaman and Nicobar Police Fire Service is creating public awareness programs for schools, hospitals, Govt. offices, etc. Andaman and Nicobar Police Fire Service should have a dedicated Education Van in each district for the purpose. The van should be equipped with short video films as produced by MHA, distribution of pamphlets on “DO”s and “DON’T”s generated by MHA, and live demonstration of how to use “portable extinguishers” and handle small fires.
6. Andaman and Nicobar Police Fire Service needs to strengthen Fire Prevention wing (inspection, awareness, and training) so that in future, fire events similar to that of AMRI, Kolkata can be prevented. For this, Andaman and Nicobar Police Fire Service Fire Prevention Wing should carryout regular fire drills and fire-inspection, awareness and training to public personnel living in important buildings, such as schools, high-rise buildings, and hospitals.
7. Though Andaman and Nicobar Police Fire Service does have promotional avenues for their staff. There is a need to have merit-based promotion, so that deserving employees remain motivated and do not leave the organization at midst of their career.
8. Audit by a central authority to ensure good finance mechanism for capital, and O&M expenditures.

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